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CIVIL ENGINEERING.

Report of the President and Directors of the Harrisburg, Portsmouth, Mountjoy, and Lancaster Railroad Company, to the Stockholders, September 3rd, 1847.

The Board of Directors of the Harrisburg, Portsmouth, Mountjoy, and Lancaster Railroad Company, beg leave to submit to the Stockholders their Annual Report, showing the condition of the Company on the 1st day of September, 1847, and tabular statements of the business for the past fiscal year.

It will be seen, from the statements annexed, that the receipts of the Company from all sources have been $114,030·47, for the year ending September 1, 1847, being an increase of $20,926·66 over those of the previous year.

Since the last Annual Report of the Directors, the unfinished part of the road has been completed, and the whole line from Dillerville to Harrisburg, has been repaired and put in complete order.

The *Bridges* and *Culverts* along the road have all been kept in good repair. The two stone piers, mentioned in the last report as then being built under the bridge over the Swatara creek, have been finished, and the bridge itself has been thoroughly repaired. This bridge is now in so good a condition, that it will in all probability last for a number of years, with but little, if any, expense to the Company.

The Board have constructed two additional trestles under the Conawago Bridge, taken out a portion of the old timber and replaced it with new, and have relaid the flooring and otherwise repaired and

strengthened the structure. The bridge across the little Conestoga Creek, and that over the small canal at Middletown, have both been renewed.

The *Tunnel* near Elizabethtown, the only one on the road, is a well built structure; it is now in good condition and has been kept well drained.

The *Weigh Scales* at Harrisburg and Dillerville, are in excellent order. The old scales at Dillerville were recently taken up, and new ones laid in their place, on granite foundations. These scales were manufactured by Messrs. Ellicott & Abbot, and have proved in all respects equal to those on the Company's road near Harrisburg.

In consequence of the increase of business over the road, the old sideings at Dillerville have been renewed, and a new turnout, over 1500 feet in length, is now in process of construction, which will greatly facilitate the business at that point. There has been a new turnout laid down at Highspire, upwards of 500 feet long. The passenger trains now pass each other at this place, instead of at Middletown, the former passing place. By this new arrangement the morning train from Philadelphia is always enabled to make a considerable gain of time, frequently reaching Harrisburg before the leaving of the afternoon train for this city. The other train (the night line) from Philadelphia, now reaches Harrisburg before the 8 o'clock morning train leaves that place, furnishing, in this way, another important accommodation to the traveling public.

The *Real Estate*, and other property of the Company at Harrisburg, have been much improved since the last Annual Report. The water slips at that place have been cleaned out, and the wharves repaired. Two of the warehouses also have required particular attention; the foundations which had given way have been in part rebuilt, the flooring has been repaired, and part of the superstructure replaced with new timber. New curved tracks have been laid down to all the warehouses. The property of the Company at this place is large and valuable. It is advantageously situated on the Pennsylvania Canal, and will become the place of connexion between the road of this Company and the Pennsylvania Railroad. It now rents for $1950 per annum.

The *Passenger Depot* at Harrisburg will require some alterations and improvements. It is not sufficiently large to accommodate the traveling public, and protect the cars from the weather.

The *Machine Shop* and *Machinery* have been thoroughly repaired. A new and powerful sliding lathe for turning and drilling has been put up, which will greatly facilitate the operations of the workmen.

In consequence of the underwash on the river bank, from the frequent freshets in the Susquehanna, the Board of Directors have found it necessary for the preservation of the road to build a slope wall a considerable distance along the bank of the river. This wall is now nearly completed.

Since the road has been substantially improved and completed, the running time for the passenger trains between Harrisburg and Dillerville seldom exceeds two hours, including stoppages. Previous to

this improvement, it was frequently three. This increase of accommodation to the public, has largely promoted the interests of the Company, by increasing the travel over the road. The completion of this work of improvement also enabled the Company to enter more extensively into the transportation of freight, and arrangements were accordingly made for that purpose. It was found necessary from the great increase of business, in the way both of passengers and freight, to procure more powerful engines to do the business of the road.

A contract was accordingly made with M. W. Baldwin, Esq., on the 10th of February last, to build for the Company, a heavy six wheel connecting freight engine, to be finished in time for the commencement of the spring business. This engine, called the Washington, was completed and running on the road in less than five weeks from the period of first making the contract. The work performed by this engine when in use, has been found to be more than equal to any other three of the Company's best engines; while the running expenses of the Washington, for each trip, was but one dollar more than that of each of the smaller engines. The capacity and power of the Washington have fully met the expectations of the Board, and her performance thus far entirely sustains the guarantee of the maker.

Another contract was subsequently made with Mr. Baldwin, for an eight wheel engine, with four driving wheels connected, combining both power and speed, to be used for passengers and freight.

This engine was placed on the road, the 22nd of August last; it has not as yet been sufficiently tried to test its power and speed. The Board, however, have no doubt its performance will prove quite as satisfactory as the other, for the purposes intended.

The cost of these two engines is $14,093. Two of the old engines, being no longer needed, have been disposed of. The other locomotives belonging to the Company, six in number, are all in good order, and will require but little repair for the coming year.

The Board of Directors take great pleasure in being able to make an exhibit to the Stockholders of the financial affairs of the Company, in their present greatly improved condition. The difficulty and embarrassments, under which they labored for a long time, have been almost entirely removed. The debt due the Messrs. D. & J. Salomons of London, which was secured by the assignment, has been paid off, and the lien removed. The Trustees under this assignment, have therefore been enabled to restore to the Board of Directors, the control of the property and income of the Company, which are now under their exclusive management and direction. This important arrangement was accomplished in June last, by borrowing $40,000, at an interest of 6 per cent. payable in ten instalments of $4000 each; the last falling due on the 15th of June, 1848. Two of these instalments, amounting to $8000, have been already met at maturity. After applying the proceeds of the above loan to paying the claim of the Messrs. Salomons, amounting to $36,072·29, the balance was paid to Messrs. Betts, Pusey, & Harlan, in satisfaction of a judgment which they held against the Company.

The Directors are unwilling to let this opportunity pass, without

expressing their thanks and those of the Stockholders, to the Trustees (Messrs. Fraley, Lex, and Linnard), for their faithful discharge of the duties devolving on them by virtue of the trust referred to, and for the courtesy and fairness which has characterized their intercourse with the Board, during the whole time of its existence.

In reference to the business of the road for the past year, the Board believes that the Stockholders have great reason to congratulate themselves with the result. Although the general expenses may appear large, they will bear in mind, that since the last annual report, the Board of Directors have purchased two new and powerful engines at a cost of over $14,000, which are worth that money at the present time; they have also paid near $3000 damages for using patent curves. It will further be seen, by the last year's report, that the expenses for August, 1846, were not included in the current expenses of the last fiscal year. The new track, which was not then finished, has been since completed at a cost of upwards of $20,000. These extra expenses, amounting to more than $36,000, should not be estimated in the ordinary expenses of the road.

The great objects for which the Board have been for a long time anxiously laboring, have been accomplished; viz., the renewal and improvement of the road, and the raising of the assignment. The Company is now enabled to work the road at much less expense than formerly; and in addition to this, the business over it has increased and must still further increase largely; so that hereafter there will be, from the profits of the road, a considerable surplus left after paying the current expenses and the interest on the loans. This surplus, the Board think, should be applied to the liquidation of the present floating debt of the Company, amounting to only $47,000. Having accomplished this desirable result, regular dividends of the profits to the Stockholders may be expected, without any apparent probability of their interruption for the future.

An energetic commencement has already been made in the construction of the Pennsylvania Railroad; and as the value and importance of the road belonging to this Company is greatly increased by the connexion with that great undertaking, the Board beg leave to refer the Stockholders to the 11th section of the Act of Assembly, passed April 13th, 1846, incorporating the Pennsylvania Railroad Company; which section provides for the connexion of that road with this Company's road, in the following words:

"Beginning at and uniting with the western terminus of the Harrisburg, Portsmouth, Mountjoy, and Lancaster Railroad, in the borough of Harrisburg, provided said Harrisburg, Portsmouth, Mountjoy, and Lancaster Railroad Company shall be subject to, and consent to the same rate of tax on tonnage, for the use of the State, as is provided to be paid in this act by the Pennsylvania Railroad Company; and in case the said Harrisburg, Portsmouth, Mountjoy, and Lancaster Railroad Company should not agree to comply with these conditions within three months after the distance of fifteen miles from Harrisburg, westward, shall bona fide be put under contract, the said Pennsylvania Railroad Company are authorized to connect this road

with the Columbia Railroad, at or near the borough of Columbia, in Lancaster County," &c.

At a stated meeting of the Board of Directors, held July 2nd, 1847, the above provisions of the 11th section of the said act were laid before the Board; and at a subsequent meeting, held August the 28th, the following preamble and resolutions were read and taken up for consideration, viz.:—

Whereas, the Act of the General Assembly of Pennsylvania, passed the 13th of April, 1846, incorporating the Pennsylvania Railroad Company, provides, in the 11th section thereof, that the consent of this Company shall be given to certain conditions therein referred to, within a specified period: and whereas, the Board of Directors of the Pennsylvania Railroad Company, did, on or about the 15th day of July, 1846, bona fide, put under contract the distance of fifteen miles of the said road from Harrisburg, westwardly, therefore,—

Resolved, That the Harrisburg, Portsmouth, Mountjoy, and Lancaster Railroad Company hereby consents to be subject to the same rate of tax on tonnage, for the use of the State of Pennsylvania, as is provided to be paid by the Pennsylvania Railroad Company, during the same periods and under the same terms and regulations as is provided in the Act of the General Assembly of the State of Pennsylvania, entitled, "An Act to incorporate the Pennsylvania Railroad Company," passed the 13th day of April, A. D., 1846.

Resolved, That the President of this Board be and he is hereby directed to inform the Secretary of State, and the President of the Pennsylvania Railroad Company, of the consent of the Harrisburg, Portsmouth, Mountjoy, and Lancaster Railroad Company, granted by the foregoing resolution, and to furnish them with copies thereof, to be respectively laid before the Governor of the Commonwealth, and the Board of Directors of the Pennsylvania Railroad Company.

Whereupon the following resolution was unanimously adopted:—

Resolved, That the foregoing preamble and resolutions be referred to the Stockholders at their annual meeting on the 3rd of September proximo, with the recommendation that the same be adopted by the Stockholders.

All of which is respectfully submitted.

By order of the Board of Directors,

September 3, 1847. JOSEPH YEAGER, *President.*

Statement of the whole Receipts and Expenditures of the Company for the Fiscal Year, commencing September 1st, 1846, and ending August 31, 1847; also with the balances of Cash on hand, taken from the Accounts of the Trustees, to the 1st of June last, from the former and present Treasurer, and the Superintendent.

To balance in hands of Trustees, 1st Sept., 1846,	$ 386 07
To balance in hands of Treasurer, 1st Sept., 1846,	4,779 70
Carried over,	$5,165 77

Brought over	$ 5,165 77
To cash received by Trustees to 1st of June last, from passengers, freights, mails, rents, &c., .	84,266 91
To cash received in June, July, and August, for passengers, mails, rents, and freights, &c., . .	26,584 09
To cash for sale of old materials, . . .	3,179 47
To cash from loan to remove the assignment, .	40,000 00
	$159,196 24

Disbursed as follows, viz.:

By cash paid interest on Company's loans and debts,	$35,426 86
By cash paid discount on uncurrent money, .	201 83
By cash paid this amount of Company's debts,	52,404 17
By cash paid on account of new locomotives, .	3,500 00
By cash paid for repairing and running the road for 13 months, per statement, ...	34,877 16
By cash paid by Superintendent for materials and labor in reconstructing road, ...	20,051 81
By cash paid insurance on property and taxes, . .	1,349 10
By cash paid salaries, President, Treasurer, Secretary, office rent, stationery, &c., ...	3,438 60
By cash paid damages, Attorney's fees, &c., . .	3,333 91
By cash paid expenses of Trust to 1st June, . .	1,600 00
By cash paid old debts, ...	20 00
By balance in hands of Treasurer, ...	2,992 80
	$159,196 24

Abstract of Freight Business.

MONTHS.	Tolls Eastward collected at Harrisburg.	Tolls Westward, collected at Dillerville.	Whole Amount.
1846. September,	$ 877 63	$1,256 27	$2,133 90
October,	976 26	1,083 12	2,059 38
November,	1,194 99	748 71	1,943 70
December,	1,211 89	865 91	2,077 80
1847. January,	1,804 61	1,149 77	2,954 38
February,	2,800 94	1,846 84	4,647 78
March,	2,652 94	2,987 41	5,640 35
April,	1,435 12	1,415 96	2,851 08
May,	966 32	913 00	1,879 32
June,	1,000 03	844 92	1,844 95
July,	472 16	537 54	1,009 70
August,	385 19	534 45	919 64
	$15,778 08	$14,183 90	$29,961 98

Abstract of Passenger Business.

MONTHS.	Miles traveled by Passengers.	Equivalent of through Passengers.	Average Receipt from each Passenger.	Whole Amount from Passengers.
1846. September,	164,234	4,562	$1 40	$6,386 85
October,	182,304	5,064	1 40	7,089 59
November,	128,065	3,557	1 40	4,980 34
December,	85,577	2,377	1 40	3,326 95
1847. January,	97,170	2,699	1 40	3,778 85
February,	91,139	2,531	1 40	3,544 29
March,	162,474	4,513	1 40	6,318 45
April,	235,948	6,554	1 40	9,175 77
May,	191,332	5,314	1 40	7,440 63
June,	188,090	5,224	1 40	7,314 54
July,	157,332	4,370	1 40	6,118 46
August,	172,917	4,803	1 40	6,724 54
	1,856,582	51,568		$72,199 26

Abstract of Receipts from Passengers, Freights, Rents, Mails, &c., &c., for the past year.

Receipts from Passengers, ...	$72,199 26
Do. Freight, ...	29,961 98
Do. Mails, ...	6,300 00
Do. Rents, ...	1,850 00
Do. extra Freight and Baggage, . .	539 76
	110,851 00
Receipts from sale of old materials, during the year,	3,179 47
Total income for year, .	$114,030 47

This statement shows that the receipts for passengers are $72,199,-26, equal to 51,568 through passengers, at $1·40 each.

The eastward tolls on freight amount to . .	15,778 08
The westward tolls on freight amount to .	14,183 90
	$29,961 98

The following statement shows the amount and character of the Company's loans and debts, viz.:

Five per cent. sterling bonds, sold in London, redeemable in 1858, £64,500 at 4·85, . .	$312,825 00
Six per cent. bonds and debts funded until 1858, in the United States, ...	258,582 45
Carried over,	$571,407 45

Brought over,		$571,407 45
Unfunded debt,		46,602 70
		618,010 15
Unclaimed interest due,		450 00
		$618,460 15

A Statement of the General Expenses of the Company from 1st August, 1846, to 1st September, 1847 (13 months), including the Amount expended by the Superintendent for Repairs, Materials, Workmen, and Reconstructing Road, &c., &c.

1.	Repairs of roadway, bridges, culverts, and superstructure, between Elizabethtown and Dillerville,		$2,534 05
2.	Repairs of roadway, bridges, culverts, slope-wall, and superstructure, between Elizabethtown and Harrisburg,		6,883 93
3.	Repairs and improvement of depôt, machine shop, warehouses, water slips, water stations, and new weigh scales, &c., &c.,		1,213 16
4.	Repairs of locomotives, tenders, and construction of new turning lathe,		4,640 04
5.	Repairs of baggage and passenger cars, &c., &c.,		1,189 96
6.	Expense of wood,		4,357 88
7	Expense of coal,		706 43
8.	Expense of oil and cotton waste,		940 38
9.	Wages of engine men and firemen,		4,508 25
10.	Wages of laborers engaged in pumping water, tending switches, sawing wood, watching depôts and bridges,		3,085 88
11.	Expense of carrying mail to post offices,		250 00
12.	Salaries of superintendent, collectors, and conductors,		3,549 81
13.	Hire of locomotives and cars to D. Lapsley, trustee,		1,017 39
			34,877 16
14.	Amount paid by superintendent for materials and labor in reconstructing Company's road,	$20,051 81	
15.	Insurance on property and taxes,	1,349 10	
16.	Salaries of president, treasurer, and secretary, with office expenses, rent, printing, and stationery, in Philadelphia and Harrisburg,	3,438 60	
17.	Damages, attorney's fees, and legal expenses, &c.,	3,333 91	
18.	Expenses of trust, paid trustees and secretary to 1st June last,	1,600 00	
19.	Old debts paid, incurred prior to 7th September, 1842,	20,00	
			29,793 42
			$64,670 58

Explosion of the "Cricket" Steamboat, on the Thames.

The Cricket was a small steamer, running between the Adelphi Pier and London Bridge, at the fare of one halfpenny for each passenger. She had already made two passages, and was lying off the pier, about to start on her third trip, when the accident occurred. There were about 150 passengers on board at the time of the explosion, who were quietly seated, awaiting the departure of the boat. Five were killed, and forty or fifty greatly injured. We extract, from late London papers, the following report and testimony concerning the supposed cause of this frightful accident.

An examination of the wreck has been made by Mr. Elijah Galloway, civil engineer, of Buckingham Street, whose report is as follows:—

"There are two boilers abreast of each other, one of which (the starboard boiler) exploded. The boilers are tubular, the fire being placed in a large tube, say of three or four feet in diameter, within the boiler, and therefore surrounded by water. The flame or heated air is returned to the front of the boiler, by about 60 or 70 tubes, of about two inches diameter, and it is the use of these small tubes that gives the boilers the name of 'tubular.' The chief advantage of these boilers is, that a larger heating surface is obtained in a smaller space, than when the old fashioned flues were exclusively used. Tubular boilers have recently obtained very general use, both in the Government and mercantile marine, though not in many instances to generate what is termed high-pressure steam, for steam vessels. It is by no means to be concluded, however, that there is any peculiar danger in the use of high-pressure steam in steam vessels, any more than in locomotives, the latter of which can necessarily be worked only by high-pressure steam; and, although it is believed the ordinary pressure generally much exceeds that which it is alleged these boilers worked, the explosion of a locomotive boiler is very rarely heard of, and is, indeed, a casualty now considered all but impossible.

"The explosion seems to have commenced by the separation of the front plate, (into which the fire-tube and the smaller pipes are fixed,) from what is termed the shell of the boiler. The dome, which is a sort of reservoir placed over the shell, is also separated, and has not yet been found, although means have been taken to recover it; because, without it, it is difficult, and perhaps impossible, to ascertain whether the dome was blown off by the force of the steam, or separated by the flight of the boiler towards the stern. It appears evident that, upon the separation of the front plate, the shell of the boiler flew away from the front plates and tubes in one piece, like the shell of a rocket, the front plates and tubes being propelled in an opposite direction, against the framing of the engine, as is demonstrated by considerable indentations on the front plate, and corresponding with similar marks on the framing of the machinery. But for the interruption

thus given to the progress of the front and tubes, the fore cabin, and the passengers on the fore deck, must have shared a similar fate to those on the after deck. The progress of the shell of the boiler is clearly shown to have been in a direction nearly aft, or rather taking a course slightly inclined from the starboard to the larboard side, cutting through the iron bulkhead, through the timbers, and finally opening a passage through the run of the vessel, cutting most, if not all, the angle irons, which form what would be the timbers of a wooden vessel, dividing the rudder post in three pieces, and laying the two sides of the vessel, which were nearly vertical, almost flat.

"The funnel and the outer casing around the boiler, being made of weak iron, appeared to have been blown upwards from the pressure of escaped steam from the boiler, the force of which they were totally inadequate to resist. The funnel and the casing carried away the bridge between the paddle-boxes, or gangway, on which the captain stands, and fell alongside into the water.

"The small tubes of the boiler are comparatively uninjured, only two of them being slightly bent, and this most likely arose from the forcible detachment of the front plate. The tubes of the upper range are found to be covered with the usual incrustation or deposit from the water. Their condition indicates that the accident did not arise from any lack of the proper supply of water in the boiler."

We believe that a saving of not less than one ton of coals per day is gained by the description of engines used on board the Cricket, Ant, and Bee steamboats. The boilers of the Cricket were three-eighths of an inch thick in every part except the steam chest or dome, which was five-sixths of an inch thick. The tube plates were three-quarters of an inch thick. The boiler case was 6 feet 6 inches long, the fire-tube 2 feet 6 inches, and the smaller tubes one-eighth of an inch thick.

The inquiry into the cause of death of the unfortunate persons who lost their lives, in consequence of the fatal explosion of the Cricket steamboat, was resumed on Tuesday morning, by Mr. Bedford, coroner for Westminster, in St. Martin's workhouse. The coroner stated, that he only proposed to-day to proceed with evidence as to the names and interests of the proprietors of the company. When the engineering evidence was complete, he would proceed with it.

Jacob Edwards examined: I live in Ratcliff Highway, and am a stoker. I was employed towards the latter end of June, 1846, on board the Cricket, and I remained in her six weeks. I know that during the time I was on board the Cricket, the engine was on the high-pressure principle. Mr. Clarke succeeded in April last as engine driver. After Clarke had been there some days, the boat began to lose speed very much. Complaints were made, both by the captain and the superintendent, that the speed of the boat fell off, and I was frequently asked the reason. In consequence of those complaints, Clarke tied down the safety valves by a piece of spun yarn from the lever, with the aid of nails, both on the larboard and starboard side. They were tied to the lever outside of the weights, and the string was brought down in front of the boiler, and fastened to spike nails in a beam that was above it. The string was brought down so tight, it

was impossible for the valves to act. The valves were almost continually in that position for upwards of a fortnight. By chance he (Clarke) let them up at the side of the pier, but never when the vessel was under weigh. I have frequently set them at liberty myself, when Clarke's back was turned; but whenever he came on board again, he immediately closed them up again, tied them, and found fault with me for letting them go. I frequently observed to him that something would occur, unless he minded what he was about, and he invariably told me that his life was as sweet as mine, and to mind my own business, and that I knew nothing about it. I often spoke to the captain about it, and the captain spoke to me; he said, "What would be the consequence if an explosion took place?" and I told him that we would all be blown up. I left the Cricket in the month of April.—Two friends of Clarke's came on board, and brought some gin; and, after the gin had been drunk, he sent me ashore for another pint. Upon returning with the gin, I observed to Clarke, that, if he did not ease the valves, they would all be blown up. On that Sunday, I heard some noise in the boiler, as if plates were shaking against each other, and I called Clarke's attention to it. I begged of him to let the valves go, as there were a great number of persons in the vessel, whose lives were in danger, as well as the lives of ourselves. Clarke refused to untie them, and I immediately let them go, but he made them fast again. He again told me to mind my own business. I noticed that when the mercury gauge, which was usually at 40 or 44, had got beyond that point, we could not tell the pressure that was on. I never heard or knew what pressure the engine was intended to bear. Forty pounds was the general pressure. When there was a pressure of forty on the valve, the valve would rise. I have nothing more to state, but that I have seen Clarke, not content with tying the valves, but I have seen him put a fire bar, weighing about 14lbs., in order to keep them down, in case the hemp should burst. This was when the valves were tied down. Clarke and myself had words frequently about the valves being tied down, but it did not create ill-will, except that the valves were tied down improperly, and he said that the boat must be kept going, and he must do so. I told the proprietors about it. On coming on board on the Sunday, I took the opportunity of Clarke's absence to ease the valves, and on the next day I left the Cricket, and went on board the Bee. I was discharged on the Saturday following, by Mr. Butters, who brought me word that I was to be discharged. I went afterwards to the proprietors, to know why I was discharged, when I was told that I was discharged on account of the oration that I had made on the Sunday previously, and I answered that I should be commended, instead of being discharged, because, sooner or later, I knew there would be an explosion. I told Mr. Smith, one of the company, that the valves had been tied by Clarke, and that an accident would occur. Mr. Smith told me that, as I had made an oration on board of the vessel, in presence of a great number of people, I was discharged. Mr. Montague Chambers cross-examined this witness, as did also two other barristers, engaged by parties connected with the company. The Government had no legal

representative. Nothing was elicited, however, from the witness, contradictory to his statements, and his evidence was followed by that of

William Williams, Ashford, Kent, engineer, who said, I am not acquainted with any of the parties interested, but I volunteer my evidence. About two months ago, I was a passenger on board the Cricket steamboat, and on looking over the casing from the deck, I observed that one of the plates covering the valve was removed, and that a line of spun yarn was fast over a beam, in an oblique direction. I remarked this matter to my brother, and said that the valve was tied down. The boat was then running. I observed it for about three minutes. This course was contrary to the usual practice. The brother confirmed the evidence. Mr. Rede, musical instrument maker, and others, also proved the safety valve was tied down with string.

William Warren, engineer of King's College workshop, proved not only the same fact, but that he had, at the time, called the attention of the engineer to the matter. I have often been on board the Cricket steamboat. After the explosion, he mentioned what he had seen to Professor Cowper, of King's College, at whose instigation he gave evidence.

Joseph Buttriss, Greenwich, fitter, in the employ of Mr. Joyce, deposed that he had been occasionally driving the engines of the Cricket; found that the valves had been tied down by Clarke, and that it was because the stoker Edwards would not deny this, he was discharged. The coroner said this was all the evidence he intended to take at that time, and adjourned the inquest until the same time next day.

On Wednesday morning, at the adjourned inquest, the evidence produced were principally servants of the company, in which it was endeavored to disprove the evidence of the stoker Edwards, and to give him a bad character. The course was, however, unsuccessful; and, after the examination of Martin, the captain of the Cricket at the time of the explosion, the inquiry was adjourned until Saturday. The coroner complimented Martin on the manner in which he gave his evidence, and regretted that the other witnesses had not given their evidence in the same straightforward manner.

The Britannia Tunnel Bridge over the Menai Straits. General Pasley's Letter, and Mr. Stephenson's Reply.

General Pasley addressed lately a letter to the Times in which he made the following statements in reference to this structure; we give them in a somewhat abridged form:

As it is well known, that when examined before a select committee of the House of Commons on the sixth of May, 1845, on the means of passing the Chester and Holyhead Railway over the Menai Straits, I approved of the tubular bridge then proposed by Mr. Robert Stephenson, engineer of that company, I think it is a duty to myself, if not to the public, to offer some observations on the various projects

for effecting the same object, successively brought forward by him of which that alluded to was the second.

In his first plan, February, 1845, Mr. Stephenson proposed to throw a massive substantial bridge, with two segmental cast-iron arches, each of 350 ft. span, over the Menai Straits, having a clear height above the water, of 116 ft. in the centre, and of 50 ft. at the springing of each of those arches, which were to be supported by an intermediate pier of masonry 120 feet wide, on a shoal called Britannia Rock, and on two abutments, also of masonry. His plan of operation for putting the pieces of iron for his arches together successively, so as to balance each other, by working outwards from the upper part of the pier and of the abutments, until his semi-arches should meet at the centre of each opening, seemed to me to be crude and ill-digested at the time, and either impracticable, or nearly so. I gave Mr. Stephenson my opinion, that, in consequence of the impossibility of obtaining any support from below, a suspension bridge, such as that previously erected by Mr. Telford over the same straits, which being everywhere 100 feet high, offers no impediment to the navigation, and having in its present state strength enough to bear the heaviest railway train, but not with safety, owing to the flexibility and extraordinary undulations of the roadway in a gale of wind, might be rendered efficient for all railway purposes by four vertical trusses, one on each side of the two lines of rails, which, if of sufficient depth, would produce that rigid inflexibility of roadway, without which no railway bridge can be constructed safe; a principle first adopted by Mr. Tierney Clark in the construction of the suspension bridge at Hammersmith, and more recently by Mr. Rendell, with no less success, in his repairs of the suspension bridge at Montrose, after one-third of the roadway had been carried away by a storm, on the 11th of October, 1838. I further suggested to Mr. Stephenson, that a suspension bridge for passing a railway over the Menai Straits might be trussed to advantage by wrought-iron lattice work, such as Sir John MacNeil had adopted for passing the Dublin and Drogheda Railway over the Royal Canal near Dublin, by a bridge of 140 ft. span. Afterwards the Lords of the Admiralty employed Sir John Rennie, and Mr. Rendell, civil engineers, and Captain Vidal, R. N., to examine that part of the Menai Straits where the railway bridge was proposed, and to consider what conditions they thought necessary to prevent the navigation from being injured. On receiving their report, the Admiralty required that the Chester and Holyhead Railway Company, in making their bridge over the Menai Straits, should not construct the central pier on Britannia Rock wider or longer than 50 ft., and that there should be two openings between it and the abutments, each 450 ft. in clear width, and everywhere to be of 105 ft. in clear height above high water level.

Mr. R. Stephenson's second plan, when thus obliged to withdraw the former, was to erect a suspension bridge of the usual construction, in order to obtain a platform for his further operations as I had before suggested. But the sort of bridge which he now proposed to put together by this means was of a novel and very ingenious construction,

consisting of two large tubes of boiler iron elliptical in section, and each measuring 30 ft. by 15, in clear height and width; and he proposed that these tubes, though resting on a central pier of masonry, were to pass entirely across the straits from one side to the other. Observing the conditions prescribed by the Admiralty, it is evident that they could not be much less than 1000 feet in length, when finished.

On the 5th of April, and afterwards on the 6th of May, 1845, Mr. R. Stephenson admitted, in examination before the Select Committee of the House of Commons, that the above was the only possible mode of throwing a bridge of such large openings over the Menai Straits, but he had so much confidence in the strength and rigidity of his proposed tubes, that, after they should be placed he thought the suspension apparatus might be removed with safety. When I was examined by the same Committee, on the last-mentioned day, I gave my opinion that the tubular bridge proposed by him would be strong and safe; and that when properly fixed, it would not be injured by gales of wind, though I was not convinced that such tubes would be better than vertical trusses; but I differed entirely from the suggestion Mr. Stephenson had thrown out, as to the expediency of removing the suspension apparatus—a measure which I thought would not only be unnecessary, but that it might endanger the security of the bridge.

From this, his second project, Mr. Stephenson has since departed, having been induced to give up elliptical and adopt rectangular tubes, in consequence of experiments tried, at his request, in 1846, by Mr. W. Fairbairn, and Mr. E. Hodgkinson, both very experienced and skilful in the uses of iron, as applied to practical architecture and engineering. Not so, the decision afterwards adopted by Mr. Stephenson, of abandoning the suspension principle altogether; instead of which he now proposes to put together in succession each of his tubes, which, according to this new arrangement, will be four in number, on a bridge of boats, which will first be formed parallel to the shore, and will then be swung into the proper transverse position by the quarter circle movement, common in the practice of military bridges, after which the tube is to be suspended by chains; and though either of the sides will expose to the wind a surface of at least 1400 square ft., considerably exceeding the area of all the sails of a 28 gun ship, and will weigh, as I am told, about 1200 tons, each of these unwieldy masses is to be raised up nearly 100 feet by hydrostatic pressure, and thus deposited and fixed on the lofty pier and abutment of masonry. I feel it my duty to express my entire dissent from this rash, if not impracticable, plan of operation, which cannot even be attempted without the risk of some very serious disaster, except at the high water slack of a neap tide, and in a perfect calm.

He has now, to my knowledge, proposed three projects, which have just been described, all widely differing from each other, for passing the Chester and Holyhead Railway over the Menai Straits; and I think that his second plan, the only one which I approve, would have been sufficiently arduous in itself, without adding to the difficulty, and diminishing the safety of the attempt, by the abandonment of the suspension principle; if he persists in this, his third plan of operation,

the chances are, that the first tube which he attempts to raise will find its way to the bottom of the straits.

Since the publication of General Pasley's letter, there has been a meeting of the Chester and Holyhead Railway Company, at which Mr. Stephenson replied to the General in the following terms. We quote the Railway Record's report:

General Pasley makes only a statement, or rather gives a detail, of conversations which took place between us relative to the principle of the use of iron-tube bridges. General Pasley states at first he approved of the principle adopted by me, and there is not in his letter one paragraph to condemn that principle—nay, he distinctly repeats that he approves of the principle. What he complains of is the mode of erecting the tube. Now, Gentlemen, there are only two or three persons who know the facts connected with the mode proposed, and General Pasley cannot possibly be in possession of any information which can at all justify his prediction. (Hear, hear, hear.) The original plan was to use chains to raise the tube to a level with the platform of the railway, which chains could be removed when the tube was fixed. Afterwards, we altered the mode of raising the tube; and it is only to this mode about which General Pasley cannot know anything—for, as I have said, it has been confided only to two or three persons—that objection is taken. I believe any apprehensions that may be entertained are of a very vague character, and that it is mainly the novelty of the plan which gives rise to such apprehensions. I believe the objections have nothing in them; the plan is only an application on a gigantic scale of an old principle.

I beg to say, Gentlemen, that they have created no apprehension whatever in my mind; they have not altered my convictions in the slightest degree; and though, as in all great works, difficulties doubtless will arise in the course of their execution, these difficulties, I am satisfied, will only be such as will suggest the remedy as they occur. (Hear.) I believe nothing will occur which we shall not be able to correct. I shall myself be on the spot; and I repeat, that though I never knew any great work of any kind in which difficulties have not arisen, I entertain no doubt that in this case they will be readily surmounted. (Hear, hear.) I beg, therefore, that the proprietors will dismiss all apprehensions on this point from their minds. The scheme involved long and experimental investigations, exceeding anything that had ever taken place before; but I felt that a large expense was fully justified to test and settle the details of the bridge. (Hear, hear.) I believe we have so settled the matter; and I have reason to know that the most eminent engineers and mathematicians approve of the principle. (Hear, hear.)

Mr. Henman had understood General Pasley's objection to be, that Mr. Stephenson now intended to abandon the suspension principle which he had originally fixed upon. Now, he would be glad to know if Mr. Stephenson was of opinion that the tube, being of so large a span as 450 ft., would be able to bear the trains, and withstand the vibration, without support from chains at intermediate points.

Mr. Stephenson.—I wish it to be distinctly understood that I never

designed the chains should form an essential part of the permanent structure; they were originally proposed, not for supporting the tube, but for raising it. As we proceeded, I found that, by increasing the weight and size—or rather, I should say, the weight only, for the size has never been altered—we could dispense with the chains altogether; I believe that it may be looked upon as fully settled, that, as respects the strength of the bridge, the chains would rather be a deterioration than otherwise. As regards vibration, there are certainly various opinions; but, for my own part, I think that no vibration at all will be felt. (Hear, hear, hear.) My reason is, the relative ratio of the weights of the tube and the trains. Take, for instance a train of even 100 tons, then, as the tube is to be 1200 tons weight, I ask whether with such relative weights, the tube is likely to be thrown into vibration? I say it is impossible. If the ratio of weights were reversed —if, for instance, the train should be 1200, and the tube 100, such vibration would, undoubtedly, arise. I believe that the tube will be as firm as a rock—that it will suffer no vibration at all; at least, not more than everything does over which a train passes. (Hear, hear.)

We quote the following description of this stupendous work, in its present state of progress, from the letter of a correspondent of the Manchester Examiner:

If we suppose ourselves stationed in a boat in the middle of the Menai Straits, a few hundred yards distant from the new bridge on the south side, and suppose it finished, we shall see a wonder of the world of this kind. First, there is the middle pier rising out of the water, founded on the Britannia Rock, after which the bridge is named. This rock can be seen at low water. The breadth of this pier is 62 ft. by 53 ft. and a quarter of an inch. The blocks of stone are 7 and 8 feet long by 3 and 4 ft. in breadth and deepness, and they rise stone upon stone, until the pier is 230 ft. high. At the distance of 460 ft. on each side of this centre pier there rise, near the water's edge, two other piers of the same gigantic breadth and height; while on each side of these two piers, at the distance of 250 ft., there rise two walls. Continuing outwards, the wall on our right hand, on the Carnarvon shore, does not extend its ponderous bulk far back, for the land is high and bold, and the railway comes along its elevated brow, and at once lays hold of the bridge. But on our left hand, which is the Anglesea shore, the wall is the forehead and end of a mighty embankment, on which the railway is raised to the level of the bridge. There, then, are the four spaces before us, across which, in the iron tubes, the railway is laid, namely, two spaces on each side of the centre pier, of 460 ft. each (let the reader measure 460 ft. on a street or on a road, and he will wonder at the vastness of this structure); and two more spaces, of 250 ft. respectively, at each end. The tubes are eight in number, each of them 30 ft. on the exterior side, and 27 ft. high in the interior. Each is 14 ft. wide, and they are laid in couples parallel to each other. In the whole, with the breadth of the piers and the landward buildings, the length of the bridge is one-third of a mile. In height, the three piers are, as already said, 230 ft. Measuring from low-water mark to the bottom of the tubes, the height is 130 ft., the

tubes being 30 ft. on the side, and the pier 70 ft. above their upper surface. As ornaments to the two walls which rise upon each shore, are four lions, two at each end of the bridge. The lions contain about 8000 cubic feet of stone. They lie couched, and yet the height of each is 12 ft.; the greatest breadth across the body is 9 ft.; the length 25 ft.; the breadth of each paw 2 ft. 4 in. The tubes are made of plates of iron of various thicknesses, riveted together. The iron increases in thickness as we proceed towards the centre. The roofs of the tubes are formed of cells, and also the floors. These cells are formed of iron plates set on edge, the cells of the roof being within a fraction of 1 foot 9 inches square, and those of the floor being 1 foot 9 inches wide, and 2 ft. 3 in. deep. The rails on which the trains run are laid on the cells of the floor. The flat bottom, the two upright sides, and the flat roof of each tube are formed of plates, the thinnest of which is a quarter of an inch, and the thickest, three quarters of an inch. The weight of each of the four long tubes will be about 1300 tons; the weight of each of the four short ones, about 600 tons. In the whole there will be at least 7600 tons of iron used. The masonry was contracted for by B. J. Nowell and Co., at £130,000; but, from alterations in the plans, it will cost £200,000. They expect to finish the masonry by August, 1848. It will contain 1,500,000 cubic feet of stone.

Lond. Mec. Mag.

AMERICAN PATENTS.

List of American Patents which issued in the month of August, 1846,—*with Exemplifications, by* CHARLES M. KELLER, *Agent for procuring Patents, and late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in the Rat Trap;* Levi Kittinger, East Grinville, Ohio, August 8.

Claim.—"What I claim as my invention, and desire to secure by letters patent, are the sliding gates, double inclined planes, and stirrup lever, and their combination with the treadle, double-sweep crank weight, pulleys, rockers, slides, and springs, as herein described, forming and constituting my trap, and by which my trap sets itself, until the weight is run down."

The sliding gates are so combined with a double inclined plane, lever crank, and treadle, as to reset the trap, by means of a weight, which requires to be wound up at intervals, like a clock.

2. For *Improvements in the Mill for Crushing Sugar Cane;* Alfred Stillman, City of New York, August 8.

The patentee says,—"The usual method of crushing cane, is to pass it between rollers, arranged with two on one horizontal plane, and a third making pressure on one between them, and, as the cane is of a

spongy texture, the moment it is relieved from the pressure of the rollers it expands, and takes up much of the saccharine matter, by suction and capillary attraction, and, to avoid this difficulty, a second set of rollers have been combined with the first set, to re-crush the cane, after it has passed from the first; but experience has demonstrated that this will not do, for after the cane has been crushed, by passing between the first set, it forms a very thin layer, which, if passed to the second set in that condition, will be ground or cut through by the pressure of the rollers, instead of being simply crushed or squeezed, to throw out the saccharine matter. To obviate this difficulty, is the object of my invention, which consists in so connecting the two sets of rollers, as to cause the crushed cane to pass to the second set, in a considerable body or thickness, to prevent the rollers from cutting or grinding it through, by so combining the two sets of rollers, as that the cane shall be presented to the second set, in a body much thicker than when delivered by the first set."

Claim.—"I do not claim as my invention, the combination of two sets of rollers, to crush and re-crush sugar cane, as this has heretofore been essayed; but what I do claim as my invention, and desire to secure by letters patent, is so combining them, as to present the cane, after it has been crushed by the first set of rollers, to the second set, in a body much thicker than when it left the first set, the more effectually to express the saccharine matter, and to prevent the second set of rollers from cutting through the mass; the whole being effected on the principle substantially as herein described."

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3. For *Improvements in Machinery for Spinning;* Geo. E. Warring & R. E. Peterson, administrators of Alex. S. Walcott, deceased, and John Johnson, City of New York, August 8.

Claim.—"What we claim as our invention, is the forming the bobbin on the tube carrying the bobbin, or the tube itself, or the tube and bobbin combined, in such a manner, that the upper bearing at the upper end of the tube or bobbin shall be against the spindle; and the lower bearing, laterally, shall be against a fixture on or in the rail below, as described, or against a lateral bearing on the rail itself, the bobbin or tube not having any other bearing except at its two extremities. And we also claim as new, and of our invention, the placing of a roller in front of the drawing roller, and revolving the same in the direction of the arrow, and the use of the same in connexion with spinning fibrous substances."

The object of the roller referred to in the second section of the claim, is to assist in carrying up the twist. It is placed forward of the last draw roller, and the thread passes over it on its way to the flyer; the said roller being made to rotate about ten times as fast as the last draw roller.

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4. For an *Improvement in the Enema Chair;* Wm. Laighton, Portsmouth, New Hampshire, August 8.

The patentee says,—"The principal object had in view, in the man-

ner of constructing my enema chair, is so to arrange the apparatus, as that the person using it may, without rising from the seat, remove an injection pipe and its appendages, and make use of a pan which is combined with the chair; thereby rendering the use thereof more convenient than under any previous mode of constructing such apparatus."

Claim.—"Having thus fully described the manner in which I construct my enema chair, and shown the operation and use of its respective parts, what I claim therein as new, and desire to secure by letters patent, is the manner herein set forth, in which I combine the injection pipe therewith, so that it may be removed, after being used, whilst the person retains his seat—the arrangement and combination being substantially the same with that herein described."

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5. For a *Cure for Hernia, called the Appilative;* Ovando Hurlbut, Buffalo, New York, August 8.

The patentee says,—"The nature of my invention consists in constructing an appilative composition, in the shape of the truss pad, to apply to ruptures, which composition gradually heals the parts, and continues to flatten down, by the heat of the body, as the cure proceeds. My remedy is composed of the following ingredients: 1. Take the bark of the root of the common hemlock, (Pinus Canadensis.) 2. The inner bark of white oak, (Quercus Alba.) 3. Common brake root, (Pteris Aquilina.) 4. The bark of green osier; all of equal quantities, and pounded finely in its green state, then mixed and put into an iron kettle, pour rain water on it till the powder is covered, then raise the temperature to 180° Fahrenheit, and keep it constantly near the said degree of heat for three days; after this, throw the mass into a filter bag and let the fluid run off; keep the fluid, and put the drained mass into the kettle, pour water on it as before, and repeat the process till the maceration is completed. The fluids so obtained are mixed together, and the mass of the powder thrown away as useless. The said fluid is put into the kettle, the heat again raised to 180° F., and kept so till it is evaporated to the thickness of syrup. In this state it is poured into tin pans, and exposed to the action of the sun, or the moderate warmth of an oven, and continued at such a degree of heat, till it attains the consistency of pitch, and it is then fit for use."

Claim.—"Having thus fully described my improved mode of treating ruptures, what I claim therein as my invention, and desire to secure by letters patent, is constructing an appilative composition, formed in the shape of a truss pad, substantially as herein set forth, and employed and operating in the manner described."

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6. For a *Method of Lubricating Machinery with Water or other Liquids, as Substitutes for Oil;* P. S. Devlan, C. S. Wood, & John Hancock, of Chester and Philadelphia, Pennsylvania, August 8.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the reservoir, bucket wheel, box,

and gudgeon, as described, for the purpose of using water, or any liquid, as a substitute for oil, on machinery, or, in the case of using oil, to save its consumption. This water, or liquid, can be also applied by means of a spiral wheel or Archimedean screw, or any shaped wheel, screw, or elevator, that will raise water or any other liquid, and discharge it upon the journal. We also claim the introduction of the air chambers in the bucket wheel."

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7. For an *Improvement in the Striking Part of Clocks;* Thomas A. Davies, City of New York, August 12.

The patentee says,—"The nature of my invention consists in making a register, to be put upon the hour socket of a clock; also connecting this register with stops upon the striking wheel, by means of two arms, working upon a centre; also in placing new stops upon the strike wheel, and in a new combination of the striking part."

Claim.—"What I claim as new and original, and desire to secure by letters patent, is applying to the hour socket of a clock, a register, made as above described, for the purpose of counting off, as the hours go round, the stops upon the strike wheel, or the stops arranged upon the strike wheel shaft.

"I also claim the application of two arms from a centre shaft, essentially as above described, the end of one of which strikes upon a register, as above described, guiding the end of the other to stops upon the strike wheel, or to stops arranged upon the strike wheel shaft.

"I also claim the new mode of stopping the striking parts of a clock, by means of pins or stops arranged upon the strike wheel shaft, essentially as above described.

"I also claim the combination in a clock of the lifting part—the stops arranged as above described. The two arms form a centre for the objects above described, and the register, made and applied as above described—all together, or any two together."

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8. For an *Improvement in the Manufacture of Stannate, or Stannite, of Soda or Potash, used in the dyeing and printing of fabrics;* John Greenwood, John Mercer, & John Barnes, Lancaster, England, August 12.

"Our invention has for its object the manufacturing stannate or stannite of soda, or potash, in a dry crystalline or pasty state. It is well known to dyers and printers that, in making tin-preparing liquor, or stannate of soda, it has been heretofore usual to take at the rate of one gallon of what is known in the trade as oxymuriate of tin, and adding thereto twelve, sixteen, twenty, or more gallons of dilute caustic soda, and this constitutes their tin-preparing liquor, or stannate of soda, or the stannate of potash, when potash is used in the place of soda.

"Now according to our invention, the stannate is made into a dry state, or in crystals, or in a pasty state, so as to pack into a small compass, and then the parties using it prepare therefrom the desired tin-preparing liquor, by dissolving the same in water.

"We take twenty-two pounds of caustic soda, (one gallon weighing thirteen and a half pounds,) and put it in an iron crucible, heated to a low red heat, by a fire under it. When evaporation has taken place, so as to produce (or nearly so) what is called hydrate of soda—that is, until watery vapors cease to be evolved—we then add eight pounds of nitrate of soda, and four pounds of common salt (chloride of sodium.) When the mixture is at or near the fluxing heat, we add ten pounds of feathered block tin. We stir the materials together with an iron stirrer, the mass becomes dark colored and pasty, and ammonia is given off. The tin decomposing both the water of the hydrated soda, and part of the nitrate of soda, the stirring is continued, as well as the heat under the crucible, until ignition or deflagration takes place, and it becomes red or white hot, and of a pasty consistence. This product is stannate of soda. We then take it out of the crucible, and when cold, grind it into powder, and it is dry stannate of soda, suitable to be packed and sent out to the printer and dyer. But if it is desired to have it in a more pure state, we merely dissolve the dry stannate of soda in water, and allow any impurity it may contain to settle.—We take the clear liquor, and evaporate down to crystallization in an iron boiler, and as the crystals form at the bottom of the pan, we take them out, and dry them on hot iron plates; or we evaporate all down to a pasty state, not quite dry, but so dry as not to let any fluid run from it. Should stannite be desired, instead of stannate, then we take four pounds of common salt, one gallon of caustic soda, weighing thirteen and a half pounds, one pound of nitrate of soda, and four pounds of feathered block tin. We put all these at once into a hot iron crucible, over a fire, and stir and boil to dryness, still stirring the dry powder so long as any ammonia is given off. We then consider the process finished. We now remove the contents from the crucible, and it is what we call stannite of soda, in a dry state, differing from stannate, inasmuch as the tin contains only half the quantity of oxygen. In order to obtain tin-preparing liquor, we take the stannate of soda, and dissolve it in boiling water, about three pounds to one gallon, and add three, four, or five gallons of cold water to it, to form the strength required for the different styles of work, according to the discretion of the printers. This solution of stannate of soda is to be used for, and in lieu of, what is known in the arts of printing cottons and de laines, as tin-preparing liquor, or stannate of soda liquor, and we apply the stannite in the same way, and as is well understood.

"If stannate or stannite of potash is desired, then potash will be employed in place of soda, and the chemist, from the directions above given for soda, will readily prepare the stannate or stannite of potash.

Claim.—"Having thus described the nature of our invention, and the best means we are acquainted with for performing the same, we do not confine ourselves to the means above described, so long as the stannate or stannite of soda, or of potash, be produced in a dry state, or in crystals, or in the state of paste, so as to pack in a small compass for ready and convenient transport. And we would wish it to be understood, that what we claim, is the manufacturing of the stannate

and gudgeon, as described, for the purpose of using water, or any liquid, as a substitute for oil, on machinery, or, in the case of using oil, to save its consumption. This water, or liquid, can be also applied by means of a spiral wheel or Archimedean screw, or any shaped wheel, screw, or elevator, that will raise water or any other liquid, and discharge it upon the journal. We also claim the introduction of the air chambers in the bucket wheel."

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"Now according to our invention, the stannate is made into a dry state, or in crystals, or in a pasty state, so as to pack into a small compass, and then the parties using it prepare therefrom the desired tin-preparing liquor, by dissolving the same in water.

"We take twenty-two pounds of caustic soda, (one gallon weighing thirteen and a half pounds,) and put it in an iron crucible, heated to a low red heat, by a fire under it. When evaporation has taken place, so as to produce (or nearly so) what is called hydrate of soda—that is, until watery vapors cease to be evolved—we then add eight pounds of nitrate of soda, and four pounds of common salt (chloride of sodium.) When the mixture is at or near the fluxing heat, we add ten pounds of feathered block tin. We stir the materials together with an iron stirrer, the mass becomes dark colored and pasty, and ammonia is given off. The tin decomposing both the water of the hydrated soda, and part of the nitrate of soda, the stirring is continued, as well as the heat under the crucible, until ignition or deflagration takes place, and it becomes red or white hot, and of a pasty consistence. This product is stannate of soda. We then take it out of the crucible, and when cold, grind it into powder, and it is dry stannate of soda, suitable to be packed and sent out to the printer and dyer. But if it is desired to have it in a more pure state, we merely dissolve the dry stannate of soda in water, and allow any impurity it may contain to settle.—We take the clear liquor, and evaporate down to crystallization in an iron boiler, and as the crystals form at the bottom of the pan, we take them out, and dry them on hot iron plates; or we evaporate all down to a pasty state, not quite dry, but so dry as not to let any fluid run from it. Should stannite be desired, instead of stannate, then we take four pounds of common salt, one gallon of caustic soda, weighing thirteen and a half pounds, one pound of nitrate of soda, and four pounds of feathered block tin. We put all these at once into a hot iron crucible, over a fire, and stir and boil to dryness, still stirring the dry powder so long as any ammonia is given off. We then consider the process finished. We now remove the contents from the crucible, and it is what we call stannite of soda, in a dry state, differing from stannate, inasmuch as the tin contains only half the quantity of oxygen. In order to obtain tin-preparing liquor, we take the stannate of soda, and dissolve it in boiling water, about three pounds to one gallon, and add three, four, or five gallons of cold water to it, to form the strength required for the different styles of work, according to the discretion of the printers. This solution of stannate of soda is to be used for, and in lieu of, what is known in the arts of printing cottons and de laines, as tin-preparing liquor, or stannate of soda liquor, and we apply the stannite in the same way, and as is well understood.

"If stannate or stannite of potash is desired, then potash will be employed in place of soda, and the chemist, from the directions above given for soda, will readily prepare the stannate or stannite of potash.

Claim.—"Having thus described the nature of our invention, and the best means we are acquainted with for performing the same, we do not confine ourselves to the means above described, so long as the stannate or stannite of soda, or of potash, be produced in a dry state, or in crystals, or in the state of paste, so as to pack in a small compass for ready and convenient transport. And we would wish it to be understood, that what we claim, is the manufacturing of the stannate

and stannite of soda and potash, by fluxing nitrate of soda, and potash, and tin."

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9. For an *Improvement in Hot Air Furnaces for Heating Buildings;* Joseph R. Morris, New Haven, Connecticut, August 12.

Claim.—"What I claim is the manner of arranging and combining the flues and air-heating pipes as herein fully described, viz.: the ends of the air pipe being connected with an end pipe, or conductor, communicating with the space between the double walls, so that the air shall be heated and the heat equalized before it enters the furnace chamber, whether such conductors be vertical or horizontal, or in any other position attaining the same purpose.

"I also claim arranging the flues and radiators, with respect to the fire chamber of the furnace, so that the air shall impinge upon the fire chamber in the manner described."

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10. For *Improvements in the Self-acting Brake for Railroad Cars;* Edwin Hager, Chatham, New York, August 12.

We are under the necessity of omitting the claim in this instance, as it refers to, and could not be understood without, the drawings.

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11. For an *Improvement in the Cooking Stove;* Bancroft Woodcock, Wheeling, Virginia, August 12.

Claim.—"Having thus fully described the nature of my improvements in the cooking stove, what I claim therein as new, and desire to secure by letters patent, is, first, the employment of a movable or shifting hearth, by which the fire chamber may be so divided as to cut off its lower part, and leave the upper part of such size as to adapt it to the burning of wood in an economical manner.

"I claim the manner of forming and using the boilers, with their guard-plates, substantially as set forth."

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12. For *Improvements in the Hydrant;* F. H. Bartholomew, City of New York, August 12.

The patentee says,—"The object of my first improvement is to provide a means of stopping off the water which shall be self-acting, and therefore not liable to accident or negligence, and at the same time effectually avoid the bursting of the pipes by the water ram, and this I effect by closing the valve against the current or flow of the water by means of a spring or weight, the tension or gravity of which is greater than the force of the water, but which gradually overcomes it, and therefore avoids that sudden concussion which endangers the safety of the pipes, the valve thus closed having the effect of a safety valve to yield to any sudden pressure or concussion which might be too great for the pipes. And my second improvement consists in the peculiar manner of employing a stopper on the side of the valve stem for closing a small water aperture through which is discharged the

water contained in the body of the hydrant, to prevent freezing in cold weather, but which may be turned on the stem to prevent the discharge of the water in warm weather."

Claim.—"What I claim, therefore, as my invention, and desire to secure by letters patent, is the method, substantially as herein described, of closing the valve of a hydrant or stop-cock, by a spring or its equivalent, against the flow or pressure of the water or other liquid, whereby I am enabled to prevent any injurious result from the water ram, as described. And I also claim making the waste hole of the hydrant oblique, in combination with the shifting stopper, substantially as herein described, whereby the flow of water is prevented, or nearly so, whilst the valve is opened and the water within the body of the hydrant retained or discharged, when the main valve is closed, as described."

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13. For *Improvements in Bridges;* Horace Childs, Henniker, New Hampshire, August 12.

The patentee says,—"In the construction of arch bridges, with diagonal braces between the under and upper arch pieces, the practice has heretofore been to abut the braces against the posts and arch-pieces at the junction of the two; so that the two braces, on opposite sides of each post, apply all the strain to the arch-piece at one point. This necessarily tends to break it at this point, and does not transfer the strain from one part of the arch to other parts—a result so important in a good bridge.

"The object of the first part of my invention is to arrange the diagonal braces between the lower and upper arch pieces, or arch-piece and its chord, and at a sufficient distance within the posts and vertical connecting rods, as to make that portion of the arch-piece perform the function of a lever; the post or connecting rod being the fulcrum, and thus to transfer the strain applied to any part of the arch from one diagonal brace to another, throughout the series, and in this way give to the arch-truss the greatest amount of stiffness due to the amount of timber employed.

"It is also well known that bridges are exposed to much lateral strain from wind, tending to force the arch trusses over out of plumb; and as an arch loses much of its strength when out of plumb, it has become a matter of great importance to perfect a bridge against such tendencies. The second part of my invention consists in making the middle arch truss of the bridge in two parts, inclined in opposite directions, connected together at top and separated at bottom, so that they resist the action of the wind in opposite directions."

Claim.—"What I claim, therefore, as my invention, and desire to secure by letters patent, is the employment of the additional nuts upon the suspension rods under the upper end, above the lower stringers, substantially as herein described, whereby the suspension rods answer the additional purpose of counter braces, as described. And I also claim the employment of the screw-bolts combined with the thrust-

braces, and projecting beyond them sufficiently to pass through the stringers where they are united with the posts, substantially as described, whereby the brace-posts and stringers are bound together, as herein described."

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14. For an *Improvement in Truss Frames for Bridges, Roofs, &c.;* Frederick Hearback, Pittsfield, Massachusetts, August 12.

Claim.—"Although I have described the tubular beam, and claim the right to use such in a bridge, it will be evident that other arrangements or constructions of beams may be used; and therefore I do not confine myself strictly to the proportions of the various parts, as expressed in the drawings, nor to the material or materials, as above set forth; but intend to vary such as circumstances may require, while I maintain an analogous combination or combinations of them.

"I do not therefore claim as my invention the combination of diagonal thrust-braces and counter-braces (which act by thrusts,) and vertical suspension rods; but that which I do claim as my improvement thereon consists in a combination of devices by which the diagonal braces operate either by thrust or tension, at pleasure, while the vertical rods at the same time operate either by tension or thrust; the said combination by which this peculiarity is derived being composed of the attachments of the diagonal braces and counter-braces, and upper and lower stringers, together with the double sets of nuts upon the vertical rods, one set being above and the other being below each stringer; the whole being substantially as herein before specified."

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15. For an *Improvement in the Machine for Boring and Mortising Hubs, &c.;* James Munsell, Painted Post, Steuben County, New York, August 12.

The patentee says,—"My improvement consists principally in the manner in which I construct my feeding apparatus, by which the chisel is made to advance, whilst the article to be operated upon remains at rest, and, although I have applied it, and represent it as applied, to the hubs of wheels, this feeding part is applicable to mortising of all descriptions."

Claim.—"Having thus fully described the manner in which I construct my machine for the mortising of the hubs of wheels, and other articles, what I claim therein as new, and desire to secure by letters patent, is the manner in which I have constructed the feeding apparatus, and combined it with the sliding piece, so as to advance the chisel on the work, whilst the latter remains at rest, the feeding apparatus, consisting mainly of a lever, with its mortise, a feed lever and rack, and of a slot and feeding bolt, arranged and combined with the other parts substantially as herein described."

16. For *Improvements in Looms for weaving two or three ply carpets, and other figured fabrics;* E. B. Bigelow, Boston, Massachusetts, August 18.

The patentee says,—"The nature of my improvements in machinery for weaving two or three ply ingrain carpets consists, first, in the manner in which I construct and combine the cams for operating the lay, so as to give to it a vibratory intermittent motion. Second, in the manner in which I combine and operate four sets or series of shuttle boxes, said four sets or series being so arranged as to enable me to operate two of said sets or series only or the four together, as the fabric to be woven may require; the number of shuttle boxes in each set or series being varied at pleasure. Third, in the combination or organization of mechanism for raising and lowering certain of the aforesaid series of shuttle boxes, in the manner required to produce any given pattern or figure to be wrought. Fourth, in a certain combination or new organization of mechanism for operating the picker staffs or levers, by which the several shuttles are thrown in the order required. Fifth, in a certain peculiar mechanism or combination of parts, by which I am enabled to arrest the operation of the loom whenever the shuttle is thrown and does not properly enter the shuttle box intended to receive it. Sixth, in certain movable or turning guide plates applied to certain parts of the loom frame, in order to prevent accidents from occurring to the loom or a shuttle whenever the latter projects from a shuttle box."

Claim.—"Having thus explained the nature of my improvements in the aforesaid loom for weaving ingrain carpets, I shall claim therein the combination or organization of mechanism applied to each sword of the lay, for operating the lay in the manner as above described, and for the purpose of preventing the roller from wearing to such an extent as to improperly perform its office in the groove of its cam when the lay or reed thereof is required to be kept stationary during the throw of the shuttle; the said combination consisting of the groove cam (fixed upon the cam or key-shaft) the cam or passage (made through or upon the sword of the lay,) and the respective rollers, and the same being arranged and made to operate together substantially as hereinabove specified.

"I also claim the combination of four sets of shuttle-boxes and reciprocating pendulums or vibratory or moving frames, (by which they are sustained and moved from the front towards the rear of the loom, and *vice versa*,) as constructed, arranged, and operating together, and with respect to the lay of a loom and each other, substantially in any of the modes as hereinabove described, the same being for the purpose of weaving two or three ply plain or shot about ingrain carpeting, or other fabrics, as set forth.

"I also claim, in combination with the shuttle binders of each series of shuttle boxes, and the hook of the ordinary stop motion of the loom, the mechanism or organization by which I am enabled, in the employment of the several series of vibrating shuttle-boxes, to arrest the operations of the loom whenever a shuttle is thrown and does not

properly enter its intended shuttle-box; the said mechanism or organization of parts consisting of the cam, arms, and shaft from which they project the arm, with its projections, the arms and springs of either shaft, or other equivalents thereto, while the elements or members of the combination are made up of the above parts, and such additional parts as may be simply necessary to their operation, as above described.

"I also claim in its application to the plate, and the vibrating frame of shuttle-boxes immediately adjacent to it, a spring or movable guide plate, arranged and operating in the manner and for the purpose as above specified."

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17. For an *Improvement in the Manner of Accumulating Ice and Cooling Water;* John Dutton, Axton, Pennsylvania, August 18.

The patentee says,—"The nature of this invention consists in cooling water and accumulating ice, by compressing air to one-fifth its bulk, more or less, in any convenient manner, and causing it to suddenly expand to its original state, and come in contact with a body of water issuing from another vessel, and passing by the air outlet in such a manner that the water will be suddenly converted into ice, or a degree near it, on the general principle, that air, by suddenly expanding, generates cold, its capacity for heat being increased."

Claim.—"What I claim as my invention, and which I desire to secure by letters patent, is cooling and congealing water and other fluids by means of compressed air confined in the vessel, and conveyed through a tube provided with a cock, and surrounded by another tube provided with a cock, (and communicating with a reservoir of water,) and allowing it to suddenly expand, while surrounded with the water, in such a manner as to cool or congeal the water, on the principle that air, by suddenly expanding, absorbs heat, its capacity for heat being increased, as described."

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18. For an *Improvement in the Machine for Breaking and Dressing Flax and Hemp;* Smiley H. Sample, Fayette, Missouri, August 18.

The beaters are bars attached to three heads on a shaft, the middle one being of greater diameter than the two end ones, so that in their rotation the beaters generate two frustrums of cones. The middle head is cam-formed between the beaters or bars, and the concave is formed of two series of slats, each series being attached at one end, and the other ends resting against the cam-formed periphery of the middle head, so that as the beaters rotate the slats of the concave move in and out. The beaters are designated in the claim by the letters (f, f), the cam-formed periphery of the middle head, by the letters (i, i). A rest over which the hemp is fed, above the concave, by the letter E, and the elastic slats of the concave by the letters (h, h).

Claim.—"Having thus fully described the construction and operation of my improved hemp and flax breaking, scutching, and cleaning machine, what I claim therein as new, and desire to secure by letters patent, is the combination of the beaters (f, f,) and cam projections

(i, i,) arranged as above described, with the rest E, and elastic rods (h, h,) substantially in the manner and for the purpose herein set forth."

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19. For an *Improvement in the Life Preserver and Trunk;* Edward G. Fitch, New Orleans, Louisiana, August 18.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of a life-preserver and traveling trunk, by constructing the same of two water-tight apartments connected by hinges and straps of such a size and shape that they will fit to the chest of a man, and leave free play for his arms, and may be secured to him by the straps, as herein set forth, when a buoyant life-preserver may be acquired, the water-tight apartments serving for receptacles for the money and most valuable parts of a traveler's wardrobe, and the central apartment, formed by the union of the water-tight apartments by straps and hinges, with the temporary bottom and cover, serving for a receptacle for a carpet-bag, and for the least valuable part of a traveler's baggage."

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20. For *Improvements in the Machine for Turning the Heads of Wood Screws;* Thomas W. Harvey, New York, August 18.

Claim.—"What I claim as new in the within described machine for turning the heads of wood screws is, first, the particular manner in which I arrange, combine, and operate the punch or driver, the tool-holder, and the rest, which are actuated by the double grooved cutter cam, so as to co-operate in the turning of the heads of the blanks, in virtue of the arrangement of the moving parts herein fully set forth. I also claim the particular manner, herein described, of constructing the adjustable turning head, the slide or seat piece, the tool-holder sliding on the piece, between the cheek pieces, with the respective adjustments thereof, combined, arranged, and operating so as to effect the setting of the tool, substantially as herein set forth; the manner of operating the griping dies, and of separating the blanks in the hopper, and conveying them to the feeding fingers, being similar to those described and used in the machine for cutting the threads. I do not herein claim in their individual capacity such parts thereof as I deem new, having been claimed by me in their combination with the threading machine: but I do claim them in their combination with the apparatus for turning the heads, as herein described and made known."

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21. For an *Improvement in the Brake for Railroad Cars;* William Clayton, Marshalton, Pennsylvania, August 18.

The patentee says,—"This brake consists of two horizontal parallel sliding bars arranged between the wheels below the frame made to slide alternately and transversely back and forth in corresponding openings in plates, fastened to the frame, or in suitable boxes, by a

right angled connecting rod, connected by pins to the said bars, and operated or vibrated back and forth by means of a connecting rod and vibrating lever, working on a fulcrum attached to the frame, two rubbers being attached to each rod on the outside and inside of the edges so as to produce eight rubbing surfaces simultaneously against the inner and outer faces of the wheels, instead of the peripheries of the wheels as in the old plan—each bar working through the rubber of the corresponding bar on the inside of the wheel,—so that as the lever is moved towards the car, for the purpose of arresting its motion, the four rubbers will be caused to embrace or gripe the edges of the wheels, in the manner of a vise or pair of tongs."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the brake, in the manner described, to gripe the rims of the wheels, and apply the friction to the sides thereof, (instead of the peripheries,) or other modes substantially the same, by which analogous results are produced."

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22. For *Improvements in Barometers;* Peter Armand Lecomte de Fontaine Moreau, City of London, England, August 20.

Claim.—"And having now described the several purposes in which my principle may be rendered useful, I repeat that I do not confine myself to the actual details herein described, but that I claim as my invention the application of flexible air-tight diaphragms of any material sufficiently elastic, and of any form which will produce the above results; that is to say, to measure the pressure of fluids, gases, &c., by the fluxions of the said diaphragms."

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23. For *Improvements in the Sofa Bedstead;* John Needham, City of New York, August 20.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the sofa seat cushion on a hinged frame provided with a mattrass below it, so that when this frame is thrown open the mattrass on this frame shall constitute a bed independent of the sofa cushion, as herein described; and this I claim in combination with the mattrass made in the permanent frame below, as herein described.

"I also claim making the sofa-cushion and one of the mattrasses on opposite sides of the same frame in combination with springs interposed and held in place between two webbings or cloths, substantially in the manner described, so that the same springs shall answer for the mattrass and sofa cushion, without affecting one of them when the other is in use, as herein described.

"I also claim the manner of connecting the legs with the hinged frame by means of the slot and pin in combination with the socket, substantially as described, so that when the legs are drawn out they can be folded into recesses or rebates in the frame, and when pushed they will be held, to prevent them from folding over as described.

"And, finally, I claim the hinged or jointed moulding in combination with the catchers attached to and moving with the hinged frame, sub-

tantially as described, so as to liberate the moulding by the lifting of the cushion frame, as described."

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24. For an *Improvement in the Wood Screw;* Thomas J. Sloan, City of New York, August 20.

The patentee says,—"Screws have heretofore been formed gradually tapering at the core from where the thread starts to the end, by dressing the thread at each turn, and tapering screws have also been formed, but they have been found not to hold so well as those of common construction, by reason of the taper of the main part of the core; but the nature of my improved screw consists in forming, on a screw of the ordinary shape, a conical point, and extending the thread of the screw with the same pitch, but gradually diminishing in width to the end of said point; by which means the screw can be entered into the wood without boring, unless the wood is very hard, in which case it follows better, works straight, and holds more firmly, than any other heretofore made."

Claim.—"What I claim as my invention and desire to secure by letters patent, is forming on a wood screw, of ordinary shape, a conical threaded point, substantially as herein described; the thread on said point being gradually diminished to the end, as set forth above."

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25. For an *Improvement in the Scarificator for Surgical Operations;* George Tiemann, City of New York, August 20.

Claim.—"What I claim as new, and desire to secure by letters patent, is, first, the application of lancets set to cut diagonally, instead of direct; and, second, the combination with the lancet so set of the rod, spring, and trigger, arranged to act by the rack and pinions to give the required motion to the lancets; the whole constructed and operating substantially as described."

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26. For *Improvements in the Carding Engine;* Charles Pooley, Chorlton upon Medlock, England, August 22.

Claim.—"Having now described the nature of the invention, and in what manner the same is to be performed, I declare that I claim as my invention, first, the afore-described arrangement of the clearers and workers above and below the main cylinder, in combination with the arrangement for feeding and doffing at one and the same side of the cylinder, or end of the machine—the whole being substantially as above specified; second, the construction of the top roller by the combination of a cover of leather or other substantially similar material, with the body made of meshes of cloth, or other substance having like properties effecting a like purpose, as described."

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27. For *Improvements in Machinery for Weaving Fish Nets;* Peter Moulton, New Rochelle, New York, August 22.

This machine is necessarily complex, and as the claims refer to, and

are wholly dependent on, the drawings, we are under the necessity of omitting them.

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28. For an *Improvement in the Revolving Horse Rake;* Hiram S. Doolittle, Kortright, New York, August 22.

The claims, which we are under the necessity of omitting, because of their reference to the drawings, are limited, first, to the use of a ring having studs, in combination with the axle, to the centre of which it is attached, and also with a spring having slots in it to receive the studs which hold the axle of the rake, so that when the spring is depressed by the foot, the rake rotates to discharge. And, second, in the use of supplementary teeth, called spiders, which are shorter than the rake teeth, and inserted in two rows between the rows of teeth, so that they shall strike the ground in the rotation of the rake and support it, and at the same time aid in turning it.

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29. For *Improvements in Boom Derricks;* Albert D. Bishop, Brooklyn, New York, August 22.

The patentee says,—"Instead of making the boom which sustains the weight that is being lifted, as heretofore, to project all on one side of a mast, which tends to carry over the whole apparatus, and which therefore has to be sustained by guy ropes, I make the boom to extend horizontally to an equal distance beyond a short mast that turns in appropriate bearings in the upper part of a frame standard—this rear projection of the boom being provided with a brace rod which is connected with the base of the standard by a roller or rollers and rail, to admit of the free turning of the boom. The rope by which the weight is sustained and raised, passes over a pulley that has its bearings in a block that slides on two rails on one end of the boom, and moved from or towards the mast by two cords attached to the sliding block, one of them passing directly to and over a pulley let into the mast and through a hole therein; and the other passing first over a pulley at the end of the boom and then over another pulley on the mast, so that by means of these two ropes, after the weight has been raised, it can be moved towards or from the mast; the lifting rope being passed also over a pulley attached to the mast and down through the hole therein. This arrangement will admit of turning the boom in any direction to deposite the weight at any point within a circle of which the boom is the radius. The standard is a triangular pyramidal frame, with a circular base provided with an inverted circular rail under which the roller of the brace rod runs, and with two sills to rest on, or by means of wheels to run on a permanent railway to admit of moving the whole apparatus to any distance required by the extent of the work intended to be done; and the upper end of this standard is adapted to the reception and turning of the mast of the boom. The mode of framing this standard is good, and highly important as affording more stiffness and solidity for various kinds of structures, than any other mode of framing with which I am acquainted. It consists of three

posts placed at equal distances apart, and so inclined as to form a triangular pyramid, connected together by horizontal ties, and braced together by diagonal braces running in opposite directions and crossing each other; each set commences at the base of one post, runs up diagonally to the next, on one face of the pyramid, from the upper end of this brace another commences on the other face of the pyramid, and runs up at the same inclination to the next post, at the end of which and on the third face of the pyramid, another commences and runs up at the same angle to the first post to complete the circuit, and so on to the top; the other set runs up in the reverse direction, and crossing the first. In this way the system of diagonal braces commences at the base, on each face of the pyramid, extending up to the top, the ends of the braces where they come together, and on opposite sides of each post, overlap, so that one bolt passes through the ends of four braces and one post."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the boom to extend back of the mast, which turns in an elevated standard, in combination with the mode of bracing it by means of a brace-rod connected with the base of the standard by a roller and rail, to admit, at the same time, of turning the boom, as described.

"I also claim the mode of constructing the standard, by making it of three posts tied together to form an equilateral triangular pyramid, in combination with the system of diagonal braces, as herein described, whereby the structure is rendered stiff and unyielding, to resist vertical and oblique thrusts and all tendency to twist, as described."

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30. For *Improvements in the Wire Cable or Chain Suspension Bridge;* John A. Roebling, Pittsburgh, Pennsylvania, August 26.

The patentee says,—"My plan of anchorage differs very materially from the mode hitherto pursued. It is principally calculated for such locations where there is no rock and where an artificial anchorage has to be made. In most cases, the practice has been to resist the pressure of the anchor plates to which the chains or cables are attached, and which are continued below ground in a straight course,—directly by a large mass of solid masonry, constructed either in the form of arches or straight walls and butting against the abutments upon which the towers rest, which support the chains or cables. In this case, pressure is transmitted to a small surface of stone wall which has to to be constructed with great care and of the best of masonry. And as the base of this masonry is but small, its extent in length must be proportionally large so as to offer the necessary resistance.

In place of resting the anchor plate directly against a stone wall, I apply in any mode a system of timbers which serve in a manner as a foundation for the superincumbent masonry, distribute the great pressure of the anchor plates over a large surface of masonry, reduce therefore its length or depth, and by its yielding or elastic nature prevent the breaking of the anchor plates. I prefer curving the chain or cables below ground in place of continuing them straight. It is

also my practice to surround all the iron below ground by hydraulic cement and wall it in with solid masonry, in place of leaving an open channel as is the case in most suspension bridges. The cement with which I surround the chains or cables preserves them against rusting effectually. Where greater precaution is desired the chains may be enclosed in lead.

Claim.—"What I claim as my original invention, and wish to secure by letters patent, is the application of a timber foundation in place of stone, in connexion with anchor plates to support the pressure of the anchor chains or cables against the anchor masonry of a suspension bridge, for the purpose of increasing the *base* of that masonry, to increase the surface exposed to pressure, and to substitute wood as an elastic material in place of stone for the bedding of the anchor plates. The timber foundation either to occupy an inclined position, where the anchor cables or chains are continued in a straight line below ground, or to be placed horizontally when the anchor cables are curved, as exhibited in the accompanying drawings, the whole to be in substance, and in its main features, constructed as fully described above, and exhibited in the drawing."

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31. For *Improvements in Cooking Stoves;* David G. Stafford, Syracuse, New York, August 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, the extension of the hot air chamber entirely around the central portion of the oven, for the purposes herein set forth, viz.: dividing the flue space leading from the fire chamber into two lateral parts, and separating the fire chamber from contact with the oven, for the more equally diffusing heat to every portion of the same, and the reducing and regulating the temperature of the oven by means of the valve, substantially as herein set forth."

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32. *Improvements in Machinery for beaming, breaking, and fleshing Hides;* Anthony Smith, Cumberland Valley, Pennsylvania, August 26.

The scraping knife which acts on the hide is jointed to a frame that slides on the end of a jointed beam by means of a crank motion, the beam being jointed simply to enable the attendant to regulate the pressure of the scraping knife on the hide, which is secured to the top of a table that receives a reciprocating motion to move the hide from end to end while the vibration of the sliding frame carries the knife or scraper across it.

Claim.—"Having thus fully described my improvement, what I claim therein as new, and desire to secure by letters patent, is the vibrating scraper, constructed, combined, and arranged substantially in the manner and for the purpose set forth, the pressure being regulated by the operative, while the scraper is driven by power. I also claim, in combination with the above, the movable table above described on which the hides are fastened, and are moved under the knife."

33. For *Improvements in the Ice Boat, or Machinery for cutting and removing Ice in Harbors;* Wm. Blount and John Cammett, Osterville, Massachusetts, August 26.

Claim—"We therefore claim as our improvement, adapted and to be applied exclusively to the removal of ice from harbors, &c., the combination of the gang or series of saws, the lateral discharging plough, and the series of revolving tooth cylinders, the whole being arranged and operating in concert, as above described.

"Also, the manner of combining the apparatus for cutting and removing the ice with the boat so as to enable the former to be adjusted to the ice to be cut; the same consisting in applying the discharging plough, with its cutters and toothed cylinders, to the boat by means of a fulcrum, or rocking shaft, stanchions, or posts, and other contrivances connected with the same, as set forth; the whole being combined, arranged, and operated together, so as to elevate or depress the nose of the plough, as hereinafter specified.

"Also, one or more lateral wings, or ploughs, or frames, or other mechanical equivalents, as combined with the full and main lateral discharging plough, and operating to discharge the ice from the frozen surface contiguous to the side or sides of the vessel, in the manner and for the object as hereinbefore explained."

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34. For *Improvements in the Manufacture of Wire Ropes;* Robert Sterling Newall, Gateshead, England, August 26—to run fourteen years from the 6th of March, 1843, the date of the English patent.

The patentee says—"The nature of my invention consists in manufacturing wire ropes in such a manner as to carry out the following two new principles, viz.: the preventing the wires being twisted in themselves, and the keeping them equidistant from the centre of the strand, and the strands equidistant from the centre of the rope. My invention also consists in a new method of inserting fresh wires or strands, when laying the wires into a strand or the strands into a rope."

Claim.—"Having now described a means of carrying my invention into effect, I wish it to be understood that I do not claim the machinery above described as my invention, although it was invented by me, because many other methods of arranging machinery for making wire ropes on the principle I have discovered may be invented. But I claim as my invention, and desire to secure by letters patent, first, forming each strand by winding wires spirally around a flexible core without twisting the wires, and forming the rope by the winding of such strands in the same manner around a similar core, the core of the strand being about equal in size to the wires, so that every wire in the spiral of each strand shall be laid equi-distant from the centre of such strand, and every strand equi-distant from the centre of the rope. Secondly, I claim a method of inserting a fresh wire or wires, or a fresh strand or strands, in laying the wires into the strand, or the

strands into the rope, made as above, when six wires are used in making the strand, or six strands used in making the rope."

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35. For an *Improvement in the Spark Arrester;* Samuel Swett, Jr., Boston, Massachusetts, August 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is placing a heart-shaped cap or bonnet, having solid edges and reticulated sides, inside the outer case, and over the upper part of the smoke pipe, in the manner and for the purpose set forth, or other mode substantially the same and for a like purpose."

The object of the heart-formed cap is to deflect the sparks, &c., and give them a downward tendency.

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36. For *Improvements in the method of Propelling Vessels;* George W. Fulton, Brazoria, Texas, August 26.

The claim, which is omitted because of its entire dependence on the drawings, is limited to the combination of pipes, &c., for discharging jets of water at the stern of a vessel to produce the propelling action. Also, to an arrangement of parts for reversing the direction of the current. And also, to an arrangement of parts for regulating and stopping the issue of steam.

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37. For an *Improvement in the Scarificator for surgical purposes;* Adolph F. Ahrens, Philadelphia, Pennsylvania, August 26.

The fleams are attached to and moved by a plate connected with the body of the instrument by what is known as the parallel links, such as are used in the well known parallel ruler, so that when the spring is liberated the points of each fleam describe a segment of a circle in giving its cut.

Claim.—"Having thus fully described my improvements, what I claim as my invention, and desire to secure by letters patent, is the combination of a series of fleams with a plate, constructed and moved substantially in the manner and for the purpose set forth."

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38. For an *Improvement in the Horse Power for driving machinery;* Daniel Woodbury, Weathersfield, Vermont, August 26.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of gearing by means of cogs upon both sides of the main wheel, and two pinions upon one and the same inclined shaft, one at each end of the shaft: one of said pinions with the cogs on one side of the main wheel, and the other on the opposite side. This mode of gearing renders the machine much stronger, more easily worked, more durable, and less liable to injury by a sudden start of the horses, and is supported at less expense than any other mode yet discovered."

39. For an *Improvement in the Cooking Stove;* Loftus Wood, City of New York, August 26.

The patentee says—"The oven is represented as having its bottom plate corrugated, but this is not claimed as a new feature, and my improvements are independent thereof; the first of these consists in the preventing of the burning out or warping of this plate at that part where it is immediately exposed to the direct action of the fire. In this part I form a recess in the plate which I fill with a plate of soap stone or fire clay, which can be readily removed at any time, and will save great cost and prevent much inconvenience in the continued use of the stove.

"My second improvement consists in the particular arrangement of the part of the stove by which I introduce heated air into the room. This I do through tubular grate bars situated immediately back of the fire chamber, against which bars the fuel lies, and between which the heated air and gases pass into the flue under the oven. These tubes extend down through the bottom plate of the stove and terminate above in an air chamber from which the air that has been heated passes into the oven through holes made for that purpose in the fore plate thereof."

Claim.—"Having thus fully described the nature of my improvements in the cooking stove, and pointed out the manner in which the same operates, what I claim therein as new, and desire to secure by letters patent, is the particular manner in which I have arranged and combined the hollow grate bars, by causing them to ascend vertically at the rear and lower part of the fire chamber from the bottom plate of the stove, and to conduct air into the air chamber, whence it passes into the oven through openings in the fire plate thereof, for the purpose and in the manner herein set forth."

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40. For an *Improvement in Cooking Ranges;* John L. Hayes, Boston, Massachusetts, August 28.

We are under the necessity of omitting the claims, as without the drawings to which they refer entirely, the character of the invention could not be understood.

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41. For an *Improvement in Machinery for Planing Blind Slats;* Arad Woodworth, 3rd., Worcester, Massachusetts, August 28.

Claim.—"Having thus described an organized machine for planing blind slats in the directions of the grain of the wood, and upon both sides and both edges before they are discharged from it, that which I claim as my invention, is the combination of the two hoppers or receiving chambers, the planing or reducing irons to operate on two opposite sides or edges, or two opposite sides and two opposite edges of a board, and the carriages with their appendages or arms, by which the boards are moved from one hopper into the other, and out of the latter and in contact with the plane irons, as arranged and operating

together, substantially in the manner as hereinbefore specified. I also claim the pistons or boards, as combined with their respective hoppers, and operating thereon in manner and for the purpose as described."

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42. For an *Improvement in Stoves for Heating Apartments;* Loftus Wood, City of New York, August 28.

Claim.—"Having thus fully described the manner in which I construct my improved stove for the heating of apartments, what I claim therein as new, and desire to secure by letters patent, is the manner of arranging and combining the revolving register, the air chamber, and the lateral gratings, for the admission of air to the fire, the air being admitted into the chamber or space through openings in an annular register above said air space, and the draught from the air space to feed the fire being supplied thereto through four or any other preferred number of lateral gratings, in the manner set forth.

"I also claim, in combination with the foregoing, the manner of admitting air from the ash-pit into the air space by means of the curved or other suitably formed air-conductors, leading from the ash pit into said space, and governed by the opening and closing of the ash-drawer.

"The air chamber surrounds the fire-pot—the upper end of this chamber is covered by a plate with holes in it governed by a register. The air that enters this chamber through the register at top, after being heated, passes into the fire through gratings in the sides of the fire-pot.

"The ash-pan at the bottom is provided with curved air passages which conduct air to the air chamber."

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43. For an *Improvement in Tailors' Shears;* Isaac Jaques, Elizabethtown, New Jersey, August 28.

Claim.—"Having thus fully described my improvement, what I claim therein as new, and desire to secure by letters patent, is constructing the shears with the lower blade formed narrow in its vertical section, and extending out laterally sufficiently to strengthen it; and elevating the bows so that the shears can be opened and closed without elevating the lower blade from the counter; the whole being constructed substantially in the manner and for the purpose set forth."

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44. For an *Improvement in the Machine for Dressing Mill Stones;* Charles Carlisle & Edwin Eastbrook, Norwich, Vermont, August 28.

This is an adjustable train to be adjusted to the spindle of a mill stone to determine the plane of the face of a mill stone in dressing it.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the frame, herein described, with

the socket, adjusting shaft, and elevating screws, constructed and arranged substantially as above set forth."

45. For an *Improvement in the Cultivator;* William Dysert, Gettysburgh, Pennsylvania, August 28.

The teeth of this cultivator are attached to two bars, one in front and the other in rear, and each of these bars is made in two parts jointed in the middle and there connected with the beam, so that by means of these joints the bars can, on each side, be inclined to any desired angle with the line of the beam. When at right angles the teeth will be at their greatest distance apart, and by varying the angle they can be made gradually to approach the line of the beam. These jointed bars are held in any required position by bolts passing through slots in cross timbers.

Claim.—"Having thus fully described my improvements, what I claim therein as new, and desire to secure by letters patent, is the movable and jointed frame for cultivators, constructed and arranged substantially in the manner and for the purpose set forth.

"I also claim, in combination with the shovels for cultivators, the point, having a shank thereon, for the purposes above set forth."

46. For an *Improvement in Bridges;* William Howe, Springfield, Massachusetts, August 28.

This is for combining an arch with the counter braces of a truss frame, the counter braces being provided with nuts and screws to bear above and below the arch, and thus retain it in its proper relative position with reference to the truss.

Claim.—"Having thus fully described the nature of my improvements in the truss frames of bridges, what I claim therein as new, and desire to secure by letters patent, is, first, the manner in which I have combined the arch-beam with the counter-braces, and the other parts of the truss frame, by means of the regulating screws that are made to bear on the arch beam, or upon the bearing-blocks or wedge-pieces, so as to effect the same purpose. I also claim the manner of sustaining the bearing of the braces on the string pieces, by passing the metallic sockets entirely through the string pieces, so that the bearing blocks and the nuts, operate on the upper and lower ends of the sockets, and are not affected by the shrinkage of the wood work."

47. For an *Improvement in the Machine for Punching Copper;* A. H. Teeple, New York, August 28.

Claim.—"Having thus fully described the manner in which I construct my machine for punching metallic plates for sheathing, and shown the operation of the same, what I claim therein as new, and desire to secure by letters patent, is the manner in which I have combined and arranged the respective parts thereof, so as to adapt it to the purpose in view; that is to say, I claim the combining and arranging of the segment plates, with their punches and corresponding cavi-

ties, as described; said plates being geared together at their ends, and working upon suitable centres, the respective parts operating and being operated upon substantially as herein set forth. And I will here remark that double chains at each end, attached and arranged in a manner well known to machinists, may be substituted for the toothed gearing. The vibrating of the segments also may be effected by a crank motion, and other changes may be made in the particular manner of arranging some of the parts herein pointed out, without in any way departing from the general principle, or manner of construction, upon which the value of my machine is dependent; and I do not therefore intend by anything herein contained to limit myself in these particulars.

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48. For *Improvements in Machinery for Cutting Files;* Major H. Fisher, Assignor to Joseph A. Hyde, Bridgewater, Massachusetts, August 28.

The patentee says,—"In devising machinery for cutting files, a difficulty hitherto insurmountable has been experienced, which results from the variation in the hardness or density of the metal at different points of the 'blank' to be wrought upon; or to state the difficulty more practically and specifically, where the piece of metal or 'blank' is softer in some points than others, the chisel will cut deeper in such points, and as the feeding motion is regular, the chisel at its next descent will strike in the groove previously made, and merely widen said groove without forming another tooth. Serious difficulty has also been met with in accommodating the chisel edge to the 'wind' (so termed) of the 'blank' or the imperfection of its surface.

"These difficulties are avoided and surmounted by my improvements, my machine being so arranged as to imitate or perform automatically, as it were, the *manual* process which is now in vogue for cutting files, and which consists in placing the chisel edge in advance of a tooth which *has* been formed, and on the smooth part of the blank, and drawing it back until the operative feels the said tooth when the blow is immediately given with a heavy hammer which forms its succeeding tooth and its adjacent groove. In my machine this function is effected by so arranging the chisel, that for each groove and tooth its cutting edge is made to *reach out* and *slide back* in a manner substantially analogous to the manual process above specified, the movement of the chisel being produced by mechanism which will be explained in the sequel.

Claim.—"Having thus described my improved file-cutting machinery, I shall state my claim as follows: What I claim as my inventions, and desire to have secured to me by letters patent, are—

First. The springs and lip combined, (whether used with or without the auxiliary stud,) for actuating, guiding, and regulating the movements of the chisel as above described, and also any mechanical contrivances varying therefrom, but substantially the same, and combined substantially in the same manner for the same purpose.

Second. Gaining and retaining the gain upon the feed motion, substantially in the manner or upon the principles herein above set forth.

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49. For an *Improvement in the Instrument called the Wife's Protector;* John B. Beers, Rochester, New York, August 28.

FRANKLIN INSTITUTE.

Address delivered at the close of the Seventeenth Exhibition of American Manufactures, held by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, October, 1847. *By* Joseph R. Chandler, Esq.

Ladies and Gentlemen:—When called by the Committee on Exhibitions of the Franklin Institute to assist in the ceremonies and services of this occasion, I felt disposed to decline the honor intended for me, from a deep conviction that, in a place where honors follow service, I should not, by any performance of the latter, achieve for myself any portion of the former.

There is, however, a service rendered to a great cause, by the willing co-operation of the humblest instrument; and for an institution that proposes the good of all, by the perfection of manufacturing and mechanic arts, there may be a service, at least by way of encouragement, when one of the number of those who can have no interest in its labors, excepting for the general benefits of its success, stands forward, and, in the name of the community, expresses the sense of deep and lasting obligation under which that community has been placed by the successful efforts of the Institute, to promote progress in mechanic arts, to apply science in aid of labor, and to multiply all the benefits of productive industry.

The community in which we live, the communities with which this institution has formed intimate connexions, by the beneficial effects of its proceedings on their pursuits, appreciate the importance of encouragement to the arts, and the constant proximity towards perfection consequent upon properly excited and well directed emulation. There is a general concurrence in the opinion, that the Franklin Institute has wrought great benefits to the country, by its influence upon productive labor. Perhaps, in some instances an indistinct, and in others an exaggerated, idea of the value of these results may obtain; but every where the great truth is admitted, and on all hands the obligation is felt and acknowledged.

The nature and extent of proceedings already had in this great festival, and the lateness of the hour, render it important that my portion of the exercises, to be acceptable, should be limited in time; and, unwilling to draw too liberally upon the patience of the audience, I shall, without further preface, inquire into some of the benefits produced by

this society and these exhibitions; and incidentally, perhaps, while I show how infinitely beyond ordinary calculations are to be the good effects of the services of the Institute, and the frequent public exhibitions which it promotes and sustains, I may disturb a few of the less founded expectations or beliefs of advantages wrought, or to be wrought, by the society. An exaggerated expectation is as injurious as a deficient estimate of the importance of any public institution. The former exposes to mortifying and disheartening disappointments; the latter, though it retards encouraging efforts, is in the way of growing confidence, by the constant amount of success over calculation. In instituting these inquiries, I shall, in the first place, have reference to the Franklin Institute, rather than to this and the antecedent exhibitions, regarding these latter only as valuable results of the existence and labors of the former.

Of the origin and progress of the Franklin Institute I need not speak; the history is familiar to most of you here; its works are known throughout the scientific world; and the minds of the practical members of this institution have been brought into communication with those of kindred societies in Europe, thus giving an exchange of thoughts and discoveries profitable to society, and honorable to those engaged in the commerce of mind: a species of interchange in which, however we may differ in views of other commodities, we shall all, perhaps, profess ourselves friends and advocates of free trade.

Great and important to the public as are the advantages of such results, they are not, I confess, those which I would directly cite to prove the excellence of this institution over others; as many associations in this country may be engaged in this species of correspondence, without producing those ends which, in my opinion, constitute the boast of the Franklin Institute.

Whoever may have been engaged in the incipient stages of this society, or whoever may have come to the aid of this work, when the weakness of infancy demanded careful nurture, or when the struggle of its youth reflected credit upon its avowed founders, it is certain that for the first time the attention of the mechanics, the laboring artizans of this city, was awakened to a sense of their own importance by the promulgation of the plan for the establishment and extensive benefits of the institution. Members of the different crafts had indeed associated for purposes of individual advantages to provide means to support the sick and the wounded, and to minister generally to those whose contributions had gone to swell a fund to be applied to in emergencies. The Carpenters had long before formed a sort of sodality that was productive of much good in its way. The Bricklayers have a confraternity, and other crafts have undoubtedly their unions, to which the destitute and the unfortunate, who have assisted the funds, may look for aid to a prescribed amount. Excellent all these are to the extent which was contemplated in their establishment, but their founders never contemplate anything more than a sort of "beneficial society," and nothing beyond such an institution has resulted.

Each of these associations has been formed of members of one trade, so that dangerous personal rivalry in business was as likely to

result among the successful members, as help and assistance to the unsuccessful.

There are instances, indeed, in which the mechanics of various branches have united; but it has usually been for some limited object, and has generally terminated in a political confederation that has been swallowed up by the two rival political divisions of the country.

But the prospectus of the Franklin Institute seemed to appeal to no branch of the mechanic arts, to offer a single inducement to one that was not equally operative in another. The least discerning of the artizans could see that, if the society carried out its views, his position in life as a tradesman would be elevated if he only reached hold of the means presented; and that, besides the general benefit resulting to the productive classes from such an institution, there were exhibited means by which particular distinction could be attained by superior mind and superior application. Hitherto he had felt that there was no such means of elevating himself and his pursuits. He had seen the lever and noticed the fulcrum by which others had been raised; but he could not discern where the power was to stand that was to raise *him* and his craftsmen from the level upon which they had been placed.

Men had indeed attained eminence who had pursued the calling of the artizan, but these fortunate ones had willingly given the influence of their elevated position to their new associates, few or none returned from the Halls of Legislation to the work bench. Almost all of them felt that they had broken away from servitude when they ceased to labor; and even those who were elevated, without pecuniary independence, seemed, when their official term had expired, rather disposed to seek employment in some minor office, than to bring back to the workshop the credit of ex-official dignity.

Labor, then, was a burthen—mechanic pursuits were inconsistent with Legislative action—the artizan felt that though he could eat and drink like others, and provide, with his own hands, for all his physical wants, there was a barrier between him and his fellow man. That barrier the Franklin Institute proposed to remove, and those who had found themselves in a degraded caste, saw that they were to be freed from disabilities—from impediments the more insurmountable as they were found in the condition of their calling. It was soon perceived that the plan was adapted to the exigencies of the case, and that the remedy was not the application of extraneous means, but the excitement of inherent, indwelling qualities, that needed only to be called into action to connect the existing position of their possessions with that condition which they had deemed inapproachable, or if approached, irreconcilable with a connexion with the past. Hitherto the inexperienced artizan had regarded the position which did not call for manual labor—which admitted of mental culture, and social refinement, as a haven upon which he might enter, only when he put off mortality and its cares; it was at least a condition so elevated as to be wholly independent of, and unconnected with, his pursuits. The Franklin Institute seemed, in his vision, to erect the ladder by which the light-hearted mechanic might ascend to enjoy the felicity of the

upper state, and, what was more miraculous, by which he could descend to mingle his sympathies and his exertions with his fellows, whose ascensive powers were yet unimproved.

There was nothing, indeed, in the plan of organization that partook of the character of their existing societies, or that seemed to promise pecuniary aid in case of misfortune. But it was easy to perceive that the attempt to apply the principles of science to the every-day pursuits of life, was to dignify those pursuits by investing them with something of the importance which had been attached by themselves to the science, abstract and separate from its connexion with their trade.

But who were to bring about this great change? Certainly not they whose condition was to be improved by the alteration.

Men of science were to unite in the work; men whose education had given them the theory of all that the mechanic was exemplifying with his labor; these men were to bring their attainments to a common treasury, and the mechanic was to be invited to throw in his share in the partnership, and thus be invested, if not with the right of drawing pecuniary aid, still with the greater privilege of solacing his spirits, wounded by separate pursuits, and elevating his condition and his hopes by the use of the new ingredients in the means of success.

There was to be a *union;* not of hands employed alike, but of heads and hands, of mental and physical powers, so that labor should be lightened by a comprehension of the design, and genius made useful by the chastenings of practical knowledge.

We talk of the theory of equality, set forth in the great paper which declares the independence of this country, and also that mighty document which ascertains and defines the rights of men and the powers of government. But what a beautiful illustration of the theory of our institutions is found in a society that fuses into one mass, materials that had been deemed antagonistic, and removes from the most active and numerous portions of the people, the occasion of discontent!

Abroad, the discontent of one class must express itself quietly, or the established order of society will drive the malcontents back to their prescribed condition. Revolution is the only alternative. With us, discontent produces irritation, and public sentiment may be too weak for the ebullition likely to follow. The institutions of the country that leave open every avenue to distinction and wealth, are wholly unequal to the emergencies that may follow a sense of inequality in a particular and numerous class, unless a combination of circumstances tend to facilitate the ingress by these avenues. The right to rise, guaranteed by the constitution, may be productive of more vexation to those unable to exercise that right, than would be the canon of an arbitrary government, that shut out ambition by establishing castes.

The true policy of a people that proclaims equality of rights, is to labor towards an equality of condition. Of all the forms which war has assumed, that of civil contest is the worst, and civil war comes more frequently from the evidence of some legal right too largely enjoyed on one side, than from the sense of right denied to the other.

Servile war is made to assert and secure some unadmitted privilege. It is rare, because it is unsustained by any legal right; civil commotion starts upon an acknowledged right; but it is suggested by the presence of some inequality of enjoyment, the more difficult to be comprehended, from the established equality of rights. Whatever, therefore, tends to diminish the distance between the feelings, the pursuits, and enjoyments of classes of citizens, tends to promote general happiness of a positive kind, and to ensure peace and order. And the association of the limited class of theorists, with the extensive class of practical men, the union of the one head and *two* hands of society must diminish, must destroy the distance that has existed, and thus secure the object so dear to a republican government.

To this great end the Franklin Institute has ministered, and herein it has proved itself an immense political machine, leveling the inequalities of society, and preparing for that general co-operation of citizens which is the realization of all the practicable theories of Republicanism, the true development of the idea of man's being "born free and equal."

The single point at which I labor as a part of the theme of my discourse is so pregnant with suggestions, and so illustrative of the effects of republican principles, it admits of so many modes of explanation, and includes so much that relates to the social condition of our citizens, that it is in itself a proper subject for a volume, rather than a division of a short address. I must then content myself by merely presenting the subject, and leaving it for the future consideration of my auditors, all of whom have an interest either personal and direct, or by political and philanthropic sympathy for others, in the prevalence of the principles upon which the whole movement is founded, and the results of the operation of these principles as manifested in the success of the Franklin Institute.

Who of us all does not feel a pride in the consideration that the majority of those who, in the theory of this government, are the rulers, are daily exhibiting evidences of improved condition, of elevated views, of enlarged ideas of usefulness, and of extensive permanent happiness, founded on an increased rational self-respect?

The charitable institutions which characterize our city, evince the enlarged philanthropy of those among whom we live. But if it is good, laudable, meritorious, to help the miserable, give food and raiment to the suffering, how infinitely superior in all goodness is the scheme which prevents the necessity for eleemosynary aid, which keeps the foot from falling and strengthens the man in a sort of self-possession and self-dependence—that, while it connects him anew and more intimately with society upon which he may lean, prevents any feeling of obligation, by enabling him to supply his full share to the general compact, and to make him an equal partner by capital, by labor, and by profits in the great association of life

Let me not be mistaken in the hints which I have given. I do not consider that the condition of the working classes is improved by any diminution of ordinary labor. I do not count exemption from toil as any blessing.

I would not have the human form brutified by excess of labor, enforced by the tyranny of man or the tyranny of grinding necessity, but I would have all men labor in their vocation. Labor is not only the condition of health, the condition of life, but it is, in this country—nay, I may say in this age—the condition of respectability. I think all will agree with me, that human rights were never, in any former period, better understood or more respected than at present—and never since the existence of established political institutions have such a proportion of the human family been called to willing labor. Never was there a time when the idle man was so utterly insignificant in the eyes of others; never has he felt so intensely his own uselessness. Some, indeed, acknowledge the necessity of action; they have commenced here and there to show a sympathy with the growing spirit of movement which characterises the age; it is true that no general or particular benefit has resulted from their activity; they have rather been in the way of others; like Diogenes rolling his tub through the streets of Athens, they have rather served to indicate the general tendency of the public mind, than to promote the object of popular movement.

I have referred to the operations of the Franklin Institute, and the effect of its labors, as promotive of republican habits, and illustrative of the effect of republican principles. In this regard the Society is entitled to the gratitude of every citizen of this extended nation. I may, however, remark, that the Institute, in this respect, is promoting a family good, for I regard the Society itself as a child of our republican institutions. The fair legitimate offspring of those principles which include equality of rights and promote equality of enjoyment. And it is derogating nothing from the Society to give it this paternity. To deny to it self existence, is not to deny it the merit of doing good. No man is less entitled to our admiration for evident enlarged philanthropy "and all good grace to grace a gentleman," because deep down in his heart may be the well springs of religion that influence his motion and sanctify his action.

But some may deny to Republicanism the paternity of such institutions, and appeal to the existence of similar societies in monarchial governments. It is not necessary, in order to meet that objection, that I should institute an inquiry whether the associations of a cognate character have the same relation with the working classes that has the Franklin Institute. I doubt whether they have now, though they will have ere long. I omit such an inquiry because I assert that these associations, wherever formed, are the fruits of republican principles working in and purifying the whole social and political system—having utterance in various ways, but always of the same sentiment: manifesting itself in diverse types, but always from the same motive. Here where there are found no hereditary or established customs inconsistent with general equality, the movements for public good are plain and obvious, and soon productive. Abroad, they are not less manifest, but less distinct. They are discernible beneath the surface, but the form of the object partakes more or less of the incrustation above, and time and effort will be necessary for the entire develop-

ment of the plan. The revolution is going on, impatience might produce convulsions. Let us, while we give them the benefit of our example, hope that the cause will not be injured by impolitic haste.

I have hastily referred to the origin, motives, principles, and effects of the Franklin Institute, with no view of instructing my hearers on these points, but rather to keep alive the feelings in which all the good has been done, and to present anew the connexion of this institution with the principles of our government, the comforts of our people, and the requirements of our religion.

But the particular occasion on which we have assembled amid all the affluence of the production of art and science that are around us, the great holiday of the Society, and of those who are interested directly in this display—the occasion is one which suggests a reference to the *means* by which the Franklin Institute labors to promote its ends. How she awakens the pride of the laborer to new exertions without complaint. How she teaches him that "the labor we delight in physics pain." How she stimulates the liberality of the capitalist without diminishing his means.

We who have examined the various ingredients of this marvellous exhibition, now near its close, have been struck not only with the excellence of the productions displayed, but especially with the evidences of improvement in the various fabrics and productions of the loom, the crucible, the mill, or the implements of art.

Every article seems to approach perfection—every object seems as if it took all credit from the past, and ordinarily the feeling has been that we have outstripped all of other times in the texture, quality, and beauty of our productions. I doubt whether the claim to excellence will be generally allowed. It is a common error of the people of this country to judge of the state of arts generally by what they see around them, and to imagine that the improvement made in the fabrics in this country, within the present century, is the exact measure by which to judge of the progress of other nations. This is a great error. Many of the manufactures of the ancients exceeded in beauty those around us. In the product of the loom, not much has been gained in delicacy of texture, nor has the needle augmented the elegance of embroidery. The luxurious tastes of the ancients, and their command of men and means, seemed to ensure for their use a high degree of perfection in the manufacture of whatever was known to them. Silk, for example, though rare, was yet produced in astonishing delicacy of texture.

Holy scripture abounds in statements of the rich productions of the loom, chiefly, indeed, of fine linen, which, among the Hebrews, as among the Egyptians, was probably for a long time used only for the sacred garments of the priesthood. Very early we find that bonnets were made of fine *twined* linen, and even (to use the language of Scripture) the *breeches* of the priests were, by special authority made of linen; and as this material did not, at that time, enter into the manufacture of articles for ladies' dresses, we may fairly infer that, at *that* time, also, the particular garment fabricated therefrom was not allowed to the women, even to the wife of a priest.

At a later day, this seemed to be remedied, and Solomon, enumerating the virtues of a good wife, mentions in particular her manufacture of articles of fine linen—really the manufacture, for "she seeketh wool and flax, and worketh willingly with her *hands.*" Nay, not only did she *make* all these articles, but she sold them to the merchants. In the present day, the opulent manufacturer contents himself with allowing females to work with their hands in the factory, but he does not make his wife the factor—why, I do not know, unless he should fear that her superior tact in business should deprive him of titular superiority. The Scriptures are full of references to the fine fabrics of linen and wool; how fine, we do not exactly know; but from the frequent and emphatic reference to *that* quality, we may suppose that a very delicate texture was produced for the service of the temple, and subsequently for the rich and luxurious laity.

Forster, a writer of great research, asserts that silk was in good use in Arabia within five hundred years of the flood. I should suppose, however, that its use became less general in later times, as Mahomet takes particular pains to dress up his luxurious female saints, the Houris of paradise, entirely in silk—a kind of wardrobe which would not have been selected, had garments of that article been common to the faithful. These, however, denote only the material—the character and positive delicacy are not mentioned. But the Roman poets are more particular. They speak of the wonderful tenuity of the web and woof, and mention the silken dress as so exceedingly fine as to give coarseness to the wearer, so *delicate* as to create a sense of indelicacy. Horace, who is not very particular in his language when he means to satirize the vicious, speaks of a silken vest that reveals rather than conceals the person.

Caligula fringed his throne with silk, and wore a silken robe; or, perhaps, rather a robe made in part of that material. Lucan, in describing the dress of Cleopatra, says:

> Her snowy breast shines through Sidonian threads
> First by the comb of distant Seres struck,
> Divided then by Egypt's skilful toil,
> And with embroidery transparent made.

My female auditors will readily perceive, notwithstanding the use of the word embroidery, that the Queen of Egypt wore a silk lace kerchief,

> Thin gauzy cloud before a blazing sun.

Almost all the writers in the Greek and Latin language, of the Augustan age, enrich their descriptions of dresses, with accounts of silk vestments, so that we may fairly infer that at that period the ornamental portions of dresses were as rich and gorgeous as any that are now made.

Cotton fabrics were manufactured by the ancients, of exceedingly delicate texture, and indeed of all textures, from the coarse canvass used to form the sails of ships, to the most delicate portions of a lady's dress.

The very name of the sails of a ship *cabase*, was that of Cotton, as

we now poetically speak of the *canvass*, instead of the sails, of a vessel. A poet of the earliest Christian time, says:

> A muslin 'kerchief by a knot compressed,
> Passed o'er her shoulders and adorned her breast."

And we know, from good authorities, that our neighbors the Mexicans (who, by the way, stand not in a very neighborly relation with us at present) were wont to make dresses of the most delicate texture of cotton, interwoven with the finest rabbit's hair, and present them, or sell them to the nobility for waistcoats. And if there is a lady present who will, with me, venture to confess a recollection of affairs nearly half a century back, I might recall to her mind the delicate *mull mulls* which seemed to have been woven in rivalry of the gossamer web, that then was and is now, for there is no improvement in that branch of manufactures, floating in an October atmosphere.

The disclosures in Pompeii make manifest, also, that the cabinet-maker and the smith of various kinds were very expert in periods anterior to the Christian era, and that pride and opulence might command whatever taste and ingenuity could devise. There was no deficiency in mechanical skill, where there was taste to require and means to compensate. Arts, indeed, have been lost in the sand-drifts of time, and the researches of the wise and the learned have been enabled to find only the vestiges that denote the flight of the pursued.

Much of all that you see around you in these halls denoting the wonderful progress of the manufacturing and mechanic arts in this country, are little else than imitations of the products of the ancients; with occasional improvements in the quality and form, though the latter is often a professed, or rather boasted imitation of the shape that distinguished particular periods and geographical divisions in elder times. Whatever was majestic in size or delicate in form and texture, seemed to have been of other times, as well as of the present; and we occasionally bring to light some wonderful product of industry and art, unearth a pyramid, or unroll a parchment, which tells of greatness of efforts and successful exertions standing in gigantic conception as much before those of the present times, as do the remains of the Megalosaurus, of the second or middle period, before the Alligators of the mountain streams of Pennsylvania.

Nor in other matters did the past lack the means to invite us to imitation. Homer describes carpets of exceeding beauty, and every poet seems to have before him some pattern of extraordinary workmanship by which he enriched his verse, and added to the charms of his mistress. The ingenuity of the Egyptians early wove the delicate fibre of the flax into winding clothes for their dead; and when these had lost their sanctity by the death of their embalmers, further ingenuity was manifested in working the preserved mummy cloths into paper for the convenience of the poet and the conveyancer.

To what end, then, has the Franklin Institute labored? Only to restore lost arts? Only to force back, by slow degrees, this boasted and boasting age, to approximate the level of the past? Only to ornament the neck or arm of beauty with the delicate kerchief which Cos

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and Seres once supplied, or the gorgeous bracelet that the Queen of Egypt once exhibited? Have the water-powers of our country been purchased up, and the dyeing woods and insects of the southern region been employed only to manufacture and color fabrics that might vie with the vestments of the priests of Isis, or the garments of the worshippers of Cyprus? Are the vellum manufacturers of Pergamus to be the inimitable pattern-makers for the Ameses, the Wilcoxes, of our days? And the exhibition here before us, because it presents little that is more elegant than Persia, India, China, Egypt, and Rome produced, is it only the humble imitation of some ancient Bazaar, or of the store house of the manufacturers of antiquity?

To this point should public attention be directed. The Franklin Institute is a creation of the times, and while it regards itself as a great moving power, self-sustaining, self-moving, and of substantive existence, it is in fact only an instrument, a tool, adapted to the workmanship of the present age, and used by the great genius of the *times* to work out the object it has conceived.

I learn that politics are considered as among the prohibited subjects in your annual addresses, but I must depart from the rule, if any such is imposed. The prohibition, if it exists, is unnatural and unjust.—Your institution is in part political, all our relations are more or less of that character. I see nothing in our society anywhere that is not stamped with the initial or ear marks of enlarged politics; and that is as it should be. In vain do you establish a republican form of government, unless you create and keep alive social republican institutions; whatever may be the social relations of man, they soon mount up and influence his political condition. The government of a country can have very little effect upon the character and relation of the people, while all the minor institutions are constantly contributing to influence the government, and this is the more so in proportion to the republican character of the government. Those, then, who in this country are diffusing education, multiplying the means of ameliorating the condition of the many, transfusing into the lower classes, (while they are the lower classes,) the feelings, perception, and *wants* of refinement, are ministering to the diffusion and maintenance of true republicanism —not only in the perceptions, judgment, and wishes of the people, but in the character and influences of the government; because in a truly republican government, the ruling power must be constantly renewed by an unimpeded circulation, from all the extremities. That power must be central, undoubtedly, and *efficient*, but its centralization is only for the convenience of the constantly changing ingredients—and its efficiency is nothing but the general consent and co-operation of all the parts of the radii and circumference.

I stop not here to show how all our colleges, academies, and public schools—how all the philanthropic moral and religious associations of our country, tend towards the perfection of republican institutions, and the strength and permanency of republican government. Such a theme, however, is worthy the thoughts and consideration of all. But I refer directly to the exhibition of American manufactures that are

around us, that rich display of articles that owe much of their excellence to the encouragement of this institution, which has, by creating emulation, established a high standard of work. This exhibition is one of the signs of the times; one of the tokens of the advancement of the great political revolution of the age; one of the means too by which that revolution is to be completed.

All the magnificence of the elder ages to which we have referred—all the rich and almost inimitable products of antiquity of which these are but the distant semblance, for whom and for what were they? The silk, that their religion consecrated, and their poets celebrated, was set apart for the gaudy trappings of political tyranny or religious deception, or it was the meretricious ornament of vice; nay, the medium for the display of indecency. The ornaments of gold and silver, the array of purple and fine linen—what were these but the exclusive enjoyments and properties of the favored few—consistent with the character of a government that considered the people slaves—slaves to labor for the wearer of purple, or at best slaves to vote for those who condescended to put on the deceptive *candida?*

Our national institutions have suggested and the Franklin Institute has carried out the idea, that whatever is good, is the more so in proportion to its extent; and while it has suggested beauty, taste, and delicacy in the formation and texture of the multiplied products of American ingenuity, its great boast has been that it has made all these the common property of the people, accessible to all of industrious habits; thus, by delicacy and appropriate beauty, refining the taste and polishing the manners of their humble possessors.

Why, the female domestic who assists in the culinary affairs of your household, shares as directly in all these blessings as does she who directs and compensates her labors. The household servant of our times—she who would have been the common property, the chattel for use and abuse, among the ancients—she wears dresses for show and for comfort that the nobility of Greece and Rome might have envied. The silk has descended from the altar and the throne of antiquity, to the kitchen of modern days, and the holiday dress of your chamber maid, for show and comfort, would excite the envy of the mistress of Pericles and of Athens. It is true—for though Aspasia had her purple to set off the lustrous white of her exposed bust, and delicate linen to relieve the brilliancy of her carmined cheek, and Lydia sent her costly stuffs, and Tyre ministered of her gorgeous dyes, and Egypt supplied her linen, and Syria her silks—yet neither Aspasia with all her power, nor the better but less distinguished matrons of Athens, enjoyed the unrevealed luxury of Lowell muslins.

I need not press the point nor multiply illustrations. It is obvious that any movement which tends to augment comforts and make them accessible to all, is a public benefit, and whatever tends to elevate the taste, refine the manners, and enlarge the social enjoyment of the multitude, is eminently favorable to republicanism.

Let me not be told of Spartan simplicity in food and raiment and habits. Starving and freezing may make courageous soldiers, and

poverty may destroy in woman maternal affection; but in my mind short commons are always connected with occasional cribbings, and the boy who is half starved upon black broth, will not think it a crime to steal his neighbor's property, provided he can do it without detection.

The simplicity of republicanism has nothing to do with the vulgarity of ignorance and poverty—it refers to, and consists in, the absence of all complication of social distinctions and political rights; the establishment of that beautiful platform upon which the poor and the rich may meet together in the common enjoyment of all the benefits of government; that kind of equality which soon removes other distinctions, and without convulsions works out a general level for all desirable ends.

Some, I know, assert that multiplying the means of dress and cheapening the materials to the property of all classes, are productive of vanity that leads to vexation of spirit. I think not. On the contrary the only mode that I can see, of destroying the occasional vanity resulting from superiority of dress, is to make all kinds of dresses so cheap that the desirable distinction shall be in the simplicity of form. Depend upon it, infinitely more good is wrought by the elevating influences of good clothing, handsome, ornamental, than there is evil by a little excess. The cheering sun which warms the suddenly sprung weed into a gaudy flower, is necessary to the perfection of your life-sustaining corn;—so the influence of dress that makes the fool a fop, softens the character, modifies the manners, and elevates the feelings of one capable of improvement.

The benefits of the Franklin Institute are evident this evening, not more in the political influences, to which I have referred, and the multiplication and diffusion of the products of ingenious industry, for the melioration of all conditions, than in the appearances and character of the assembly attracted by the beauty and the usefulness of the congregated wonders of these halls.

No plan or principle that tends to the general improvement of man's condition is unworthy of woman's special attention; her own particular condition is identified with every meliorating effort. No new powers of good are to be conferred, but every successful attempt to improve society, confers on her new means of doing good; though there should be no enlargement in the sphere of her duty—yet there is a double efficacy in the efforts which she makes in her appropriate sphere. The work which she now does, the maternal instruction she imparts, the lessons of wisdom she gives to her children, are permanently and widely useful: they result from fixed principles and are in accordance with prevailing ideas of public good; to-morrow, with her and her lessons, shall be as this day, and much more abundant; while in other times her home-lessons, founded on no established code, were changeable, exposed to constant variation—like the web of Penelope, the morning saw unravelled what the evening had supposed complete.

Undoubtedly the circumstances of woman are greatly improved by

advancements in the arts of life, and in proportion to the prevalence of these improvements will be the advantage which woman will derive therefrom. I do not know that she is to be freed entirely from many of the evils to which her sex has always been exposed in its relations with man. In the time of Solomon, the best of women, (because the best of wives,) was represented as toiling with her household while her husband was sitting in *the gates*. And in the present times it is to be feared that too many wives are bound down to drudgery, inconsistent with the delicacy of their frames, while their husbands are sitting, if not in the gates of the city, at least within the doors of the tavern, seeking praise and pleasure from services wholly incompatible with their social and domestic duties.

But improvement in the condition of woman certainly follows the prevalence of the means of desirable comforts. The mind acquires a delicacy from the multiplication and general use of articles that at one time were deemed the special property of the wealthy. And the taste and judgment manifested in the manufacture of certain articles become extended by the use of the article manufactured. The first effect of these delicacies upon the unameliorated mind, is pride of display; the ultimate result is a chastened sentiment of delicate propriety —in woman first—and most extensively operative through her—in man later, but effective and permanent.

Most appropriate then is the presence of Woman at this exhibition; she comes to encourage, by her appearance, efforts for domestic, social, and political advantage. She comes to show for whom the delicate and the beautiful of the products of the loom have been prepared: the delicate for the delicate—for whom the odors of Araby have been distilled and diffused: "sweets to the sweet."

Her presence, while it encourages and rewards the services which bless society, is an acknowledgment of her sense of the new importance with which all these advancements in the arts have endowed her sex.

The home that is made more delightful by the multiplication of domestic comforts, is more attractive to him in whose presence woman should delight. The freedom which a refined mind enjoys from former prescribed toil, may be beautifully employed in augmenting and strengthening domestic and social affections; and meet it is, that those who are to profit by these changes should smile upon the means by which these changes are produced. Most meet it is that woman should come hither to cheer the efforts by which her domestic, her social, and her religious condition is improved; that she should bless the improvement that enables every Martha to sit, like Mary, without household cares in the hour of instruction; that gives to every Cornelia the leisure to educate and train her Gracchi; that supplies to all her sex the box of precious ointment with which religious devotion is to be manifested and the heart's deep piety expressed.

I confess to you, Mr. President, and ladies and gentlemen, that in the plan of this discourse, the stage at which I have now arrived, was but the entrance to the subject. I am admonished, however, by the time

already expended, that my duty is to leave the theme to another hand for another occasion, assured that it will never be too late to connect public good with republican principles: nor will the Franklin Institute ever fail to supply proofs, that by ministering to the former she is sustaining the latter.

I have hinted only at one means by which the Institute is doing good: she works by numerous modes, but all to the same end; extending her powers of usefulness by lectures, and her fame, and our city's honor, by her correspondence. But it is chiefly in the direct bearing of her existence and labors upon our republican institutions that I have sought to have her distinguished at the present time. On this subject we can all agree. On measures of government, there must always be such a difference, as to separate classes of citizens into distinct parties. But I love to think that the ends of all are the same, and to find, as I do here, that there are measures of general bearing on which the good and the great of every party may unite; that there is an institution in the country which, while it ensures the hearty and direct co-operation of all classes within its immediate influences, brings to its labors and its enjoyments the full consent and free-will offerings of people from every section of the vast Union, thus affording another link indissoluble and infrangible, to that chain of accidents, qualities, and institutions which,

> "Like a garland of flowers,
> Entwines all our States in a band,
> Confirms and confederates our wide spreading powers,
> Our wealth and our wisdom expands."

MECHANICS, PHYSICS, AND CHEMISTRY.

On the Cause of Evaporation, Rain, Hailstorms, and the Winds of Temperate Regions. *By* G. A. Rowell.

Mr. Rowell stated his opinion that amongst the variety of theories given in our Encyclopedias and scientific works there is not one that will *fairly* explain *all* the phenomena of evaporation; or if these phenomena are considered as fairly explained, the explanation of the cause of the suspension of clouds, rain, and every other phenomenon connected therewith requires the aid of some further hypothesis. The theory of Dr. Hutton on rain may be thought sufficient to account for moderate rains, but totally fails when applied to such heavy rain as that which fell in London, August 1st, last year, and therefore cannot with propriety be adopted in any case. Mr. Rowell endeavored to show that the phenomena of evaporation, clouds, rain, lightning, hail, the winds of temperate regions, and storms of lower latitudes, may be fairly explained by the hypothesis he submitted: *i. e.* electricity having no weight and diffusing itself equally over the surface of bodies, the minute particles of water, even in their most condensed state being completely enveloped in their natural coating of electricity, occupy, together with their electricity, nearly the space of an equal weight of air, and are thus rendered sufficiently buoyant to be carried away by the wind; but that when expanded by heat their specific gravity being

then reduced, and their capacity for electricity being increased by the increase of surface, they are then buoyed up into the air by their electrical coatings; that when the rising particle is condensed it becomes surcharged by the contraction of its surface: if this takes place near the surface of the earth, the surcharge escapes and the particle falls as dew; but if it is condensed when above the electrical attraction of the earth, it is still buoyed up by the electricity, and on the escape of the surcharge, the particles attract each other and form clouds and rain.—Hills and mountains cause clouds and rain by conducting the electricity from the vapor, and not by condensing it; and on these grounds he again suggests, as a test of the theory, the experiment he proposed to the British Association in 1840: *i. e.* "To cause rain by raising electrical conductors to the clouds by the aid of balloons." In support of the proposition he read an extract from a letter he received from Mr. W. H. Weeks, of Sandwich, dated December, 27th, 1842, in which that gentleman assures him that "It has several times happened that when his electrical kite has been raised immediately under a distended, light, fleecy cloud at a moderate elevation, and a *free current of sparks* has passed from the apparatus for some ten or twelve minutes, he has suddenly found himself bedewed with a descent of fine misty rain, and on looking up has seen the cloud upon which he was operating surprisingly reduced in magnitude." Electrical kites cannot reach the clouds, and can only be raised in windy weather, when the clouds must be every instant passing away from the influence of such apparatus; and if they have such effects, what may we not anticipate from the use of conductors which would reach the clouds, and could be raised in calm weather? Mr. Rowell considered that from the reduction of temperature at the height of the clouds, the vapor in those regions must be always condensed, but invisible from being so diffused; and that the formation of clouds is not owing to condensation, but to the escape of electricity allowing the particles of vapor to attract each other. In support of these views, and also to show that the ascent and support of vapor at great heights must depend on some agent which is independent of heat or cold, he exhibited the table following:—

Heights.	Temperature of Air.	Water heavier than Air.
Level of the Sea	+60°	860 times.
1 mile	+43	1,083 "
2 miles	+26	1,363 "
3 miles	+ 9	1,716 "
4 miles	— 8	2,160 "
5 miles	—25	2,719 "

Another cause of rain is the pressure of particles of the vapor upon each other; for if a cloud be of great depth, say the lower part one mile high and the upper part two miles, as the electricity of the particles would be equal, those in the upper part would not have sufficient

for their support, and would therefore press downwards, and those in the lower part would have more than enough to support them at that height, and would therefore press upwards, and thus press the particles in the middle of such cloud into contact and form rain, while the electricity being pressed out of the cloud, would accumulate on the surface till it could force its way to the earth or other clouds, and thus cause lightning. Violent hailstorms he attributed to the sudden equalization of the electricity of large masses of vapor floating at different heights in the air, and brought by currents and various circumstances the one over the other. The difference between the lowest mass and the top of the upper mass of clouds may amount to two or three miles. The violence of storms in such cases depends upon the density of the clouds and the height of their upper strata: as, the greater the height at which the hailstones begin to form, the greater will be the degree of cold they will acquire, and consequently the more powerfully they will act in freezing the vapor with which they come in contact during their fall; the greater also they will become by the accumulation of vapor in falling; and the greater will be the velocity with which they will arrive at the earth. The lightning accompanying such storms may be caused by the lower clouds forming conductors for the electricity from the highly-charged upper clouds to the earth. The diminution of the pressure of the atmosphere previous to and during rain, he ascribed to the escape of electricity from the invisible vapor or clouds; thus causing a vacuum or rarefaction in the regions of the clouds: and the air from its elasticity rising to fill the space, decreases the pressure on the mercury. Allowing that the trade winds, land and sea breezes, &c., are caused by changes of temperature, yet he contended that the more irregular winds are owing in a much greater degree to the fall of rain and the escape of electricity from the cloud, than to any change of temperature; for as each particle of water to be buoyant must, together with its electrical coating, occupy the space of an equal weight of air, as water is 860 times heavier than air at the level of the sea, every particle of water that falls to the earth must have occupied 860 times more space when suspended in the air; therefore, if in a given time one inch of rain falls to the earth, it must, during that time, have caused a vacuum or rarefaction in the space above to the extent of 860 inches: the vacuum would in fact be greater than this, for vapor to be buoyant must occupy a greater space according to its elevation; but as the density of the air decreases according to the elevation, the effect must be the same: *i. e.*, for every inch of rain that falls the vacuum would be equal to the gradual abstraction of the whole of the air to upwards of 70 feet in height over the whole district where the rain falls; which rarefaction must be filled up during the time the rain is falling by a rush of air from the surrounding districts, although such wind may not always be felt in the same locality in which the rain falls. He supports his views by referring to the storms of wind which swept over England from the northwest and west last autumn, at which time France and other parts of the continent were deluged with rain. He exhibited the following

table of heavy rains (mentioned by Prof. Forbes in his Report on Meteorology in 1840) to show that they are sufficient to account for violent storms; and had no doubt that if we had accurate accounts of the *extraordinary* rains which sometimes fall within the tropics, they would be found sufficient to account for the most tremendous hurricane:—

Place.	Date.	Depth of Rain in inches.	Time.	Average vacuum per square mile, per *second*, in cubic feet.
Catskill, U. S.	July 26th, 1819	18 inches	7½ hours	1,331,968 cub. ft.
Genoa,	Oct. 25th, 1832	30	24	693,733
Joyeuse,	Oct. 9th, 1827	31	22	782,027
Geneva,	May 20th, 1827	6	3	1,109 973
Gibraltar,	Nov. 27th, 1826	33	26	704,406
Naples,	Nov. 22nd, 1826	9/10	37 minutes	809,980
Perth,	Aug. 3rd, 1829	4/3	30	838,978

—*Proceedings of the Brit. Assoc.* Athenæum.

On the Cause of the Aurora, and the Declination of the Needle.

By G. A. Rowell.

As the trade winds are caused by the flowing of the denser air from the polar regions to the tropics, the superior trade winds in the higher regions of the air must be from the tropical to the coldest parts of the earth, to keep up the equilibrium of the air; then, as it is proved by Forchhammer that more vapor arises from tropical seas than falls there, and that more falls in polar regions than rises in those parts; and, as it is proved by the experiments of Volta and others, that whenever evaporation takes place, positive electricity is carried off—it follows that there are electrical currents similar to the currents of air; the vapor, with its electricity, rising in the tropics (thus rendering those parts negatively charged) is carried thence by the *superior* trade winds to the colder parts of the earth, where the vapor falls; and its electricity escaping to the earth, renders those parts positively charged, whence the electricity rushes off along the earth's surface towards the more negative parts of the earth, and is again carried off by the rising vapor. Mr. Rowell ascribes the direction of the needle to these currents of electricity from the positive to the negative parts of the earth, and the aurora to the interruption of these currents of electricity, by the dry and non-conducting state of the air in the *frigid regions* during *severe frosts* insulating the electricity of the clouds, where it accumulates till it flashes back through the higher and rarer air towards the more temperate regions, thus exhibiting the aurora, and at the same time causing a disturbance of the magnetic needle. The author thinks that many writers have fallen into error in supposing the height of the aurora to be far above the limits of our atmosphere: which error may have arisen from some mistake in their observations, or from some

other luminous meteor being mistaken for the aurora; for as the observations of Parry, Franklin, Richardson, and others distinctly prove that the aurora does take place near the surface of the earth, and is in some way connected with the formation of clouds, the arches which are sometimes seen at such great altitudes may arise from totally different causes. He considers that the diurnal variation of the needle tells in favor of the opinion that the direction of the needle is dependent on evaporation; as very early in the morning, when to the eastward of our meridian, evaporation must be at a minimum, the declination is least: the declination then *increases* till about the time when the evaporation must be most rapid, and then decreases till, in the evening, it reaches its medium position; and the fact that the diurnal variation is more than double in summer what it is in winter, tells in favor of this view. The cause of magnetic poles in this hemisphere he ascribes to the quantities of ice blocked up both in winter and summer in the high latitudes above the two continents, thus causing those parts to be the coldest in this hemisphere, and therefore the magnetic poles; for, as the density of the air from the frigid regions is the cause of the trade winds, and as the density of the air increases with the degree of cold, it follows that more air must flow from the coldest parts of the earth towards the warmer regions than from any other parts, and, consequently, there must be the greatest flow of the *superior currents* of air from the warmer to those colder parts, thus bringing more vapor and electricity there than to any other parts in this hemisphere. Now, if the greatest degree of cold be at the pole of the earth, and evaporation increased regularly thence to the equator, there would then be no declination of the needle, as the electricity would pass off from the coldest or positive parts towards the more negative parts of the earth in the direct lines of longitude; but as the magnetic poles are at a distance from the terrestrial pole, and as those parts are more positively charged with electricity than other parts in the same latitude, the electricity must diverge eastward and westward of the direct lines of longitude in passing off to the more negative parts of the earth, and thus cause the declination of the needle. The author contends that the fact that the aurora did not affect the needle at Port Bowen in 73° north latitude, whilst it had great effect at Fort Franklin in 65° north, tells in favor of his views that the direction of the needle is owing to currents of electricity from the magnetic pole to the more negative parts of the earth, as the American magnetic pole is in 70° north. Mr. Rowell exhibited a large diagram of the earth from the north pole to 40° north latitude, showing at one view the situation of the American magnetic pole according to Sir James Ross, and the Siberian pole according to Hansteen, the lines of equal intensity from Col. Sabine's maps, the lines of equal temperature from Humboldt, the direction of the needle shown by arrows, &c. By the diagram he showed that, in the meridian of the American pole, the lines of equal temperature descend to a much lower latitude than in any part of this hemisphere, which he ascribed to the polar seas there being land-locked and causing a great accumulation of ice in those regions both winter and summer, whilst the magnetic force, also,

is greatest in that meridian. In the meridian of the Siberian pole, the Polar Sea is far more open, the temperature is higher, and the magnetic intensity less. In the neighborhood of Behring's Straits, where the Polar sea is open to the Pacific Ocean, the intensity is still less; but in the meridian of London, or rather to the east of it, the line of equal temperature rises to a much higher latitude than in any other part of this hemisphere, the intensity of magnetism is the least, and the Polar Sea is there open from Greenland to Nova Zembla, and the ice formed in those regions is liable at all times to be broken up and dispersed by the storms of the Atlantic Ocean. He considers the magnetic poles not to be mere points in the earth, but extensive districts in the coldest parts, and that even mountains, which, from their elevation, are continually conducting electricity from the higher regions of the air, must have some local effect upon the needle. He contends that the opinion is erroneous which ascribes the changes of declination to a rotation of the magnetic poles round the pole of the earth; as we have no proof that the magnetic poles in this hemisphere were ever situated otherwise than in the high latitudes above the two continents; and that the change of declination may be fairly explained on the supposition that the American pole has *increased* in strength, or the Siberian pole has *decreased* in strength, and that the line of no variation where the influence of the two poles are equal, has receded during the last two centuries from some point west of England to its present position eastward of St. Petersburg, thus bringing parts which formerly had an eastward variation to be under the influence of the American pole. He suggests that any geological change which has made the Siberian Polar Sea more open, would tend to weaken that magnetic pole; or any change which may have blocked up the American Polar Sea, would increase the strength of that pole. He concludes by again suggesting the experiment of raising electrical conductors, to the height of the clouds in the frigid regions during severe frosts, which he believes would cause the aurora, and also throw some light on terrestrial magnetism. Ibid.

On Lord Rosse's Telescope.

Continued from Page 281.

Unfortunately the whole month of February was of the worst astronomical character; and though the great speculum had only the imperfect polish already noted, it was kept in the tube as long as there were any hopes of seeing the great nebula of Orion. That, however, was always clouded while within its range. A few clear minutes on the 13th allowed them to see some stars and clusters; but the only circumstances worth mentioning were, that it shewed the stars of Castor far apart *without an eye-glass*,* and that the stars of the cluster 67 Messier, which Sir J. Herschel describes as being from the eleventh to the twelfth magnitude, were many of them as bright as those of the first appear in a three and a-half feet achromatic.

At length, when all hopes of Orion were lost in the twilight, the

* Only twenty-two inches of the mirror could act in this case.

mirror was removed from the telescope, and polished on March 3d. Its frame is supported in the cubic chamber of the tube by three strong screws which give the adjustment of its optic axis. By unscrewing these, when the tube is vertical, four wheels with which the frame is furnished come to bear on a railroad fixed at the bottom of the chamber and communicating over a bridge (laid from its door when necessary) with another railway laid on an inclined plane of about sixty feet. It is drawn up this by the declination of windlass, and at its top runs on a strong truck by means of which it is drawn a quarter of a mile, on a common road, to the laboratory.

The polishing machine differs in nothing but size from that described by Lord Rosse in the Philosophical Transactions. It makes the speculum revolve once for twenty-four and a-half strokes, and the eccentric once for eighteen. From seven to eight strokes of twenty-four inches are made in the minute, and the lateral movement of the speculum by the eccentric is fourteen inches.* A screw whose nut runs on a railroad above the machine lifts the speculum, with its frame and levers, from the truck, and deposits it on the revolving platform, where it is levelled, centred, and secured. The same apparatus serves to move the polisher during its preparation and to apply it to the speculum, so that it is even more manageable than that of the three-feet was. It was cast with the transverse grooves; the circular were cut in the lathe. The time required for polishing is about six hours; and Lord Rosse has found that this period cannot be exceeded without injury to the figure, in consequence of the soft pitch being squeezed out, and the harder and unyielding material coming into contact with the iron of the polisher: unfortunately, this occurred to some extent in the present instance. The ammoniacal solution of soap used towards the close of the process, happened to be made with ammonia prepared from gas liquor and containing some substance which acted on the mirror, and produced a dullness that was not removed till after three hours' additional work. Lord Rosse warned them that the figure must be imperfect, and wished to repolish; but they overruled this proposal, and it was replaced in the tube next day.

On examining it by diaphragm and disks, it was found that, as he anticipated, the edge was not quite perfect. All its zones showed ξ Ursæ Majoris very well with 560; but the exterior six inches mani-

* These are the proportions which Lord Rosse prefers; but it must be kept in mind that they change with circumstances. *Probably* they will not answer for those specula which have an aperture larger than one-ninth of their focal length, and *certainly* not for those which are perforated in the middle. Dr. Robinson has made many experiments on one of the latter, fifteen inches aperture and nine feet focus, with a machine nearly the same as Lord Rosse's; and he finds that the nature of the polishing depends on the figure given in grinding. If the eccentric be regulated so as to make this hyperbolic, its action must be lessened in polishing so as to shorten the focus. In this way it is possible to obtain very good results. He, however, prefers the opposite course pointed out by Lord Rosse; grinding to an elliptic figure, he polishes with a very long primary stroke, and small action of the eccentric. A speculum thus polished shows ε Arietis well separated and defined with 940, and with 465 the fifth star in the trapezium of Orion's nebula is visible even when the acting surface is reduced to seventy-two circular inches.

fested, when the star was thrown out of focus, that, though of the same focal length, this portion was irregular. Few other double stars were observed, as most of the lucid interval from the 4th to the 13th of March was devoted to nebulæ, and after that it again became cloudy: but enough were seen to satisfy them that the instrument possessed a very high defining power. This, indeed, was evident from the admirable exhibition of Regulus, seen on March 5th, neat and round, without appendages or flare. Gamma Leonis, ξ Virginis, 2 Comæ, and Gamma Virginis, were also well shown with powers of 400 to 800 on an unfavorable night; and the companions of ν Ursæ, and 245 of Struve's second Catalogue, which appear in the Slough and Pulkova telescopes as of the eleventh and tenth magnitudes, seem in this large stars.

Of planetary bodies, none were visible except D'Arrest's Comet and the Moon. The former, when viewed March 10th, presented nothing remarkable: the brighter portion, towards the centre, showed no abrupt change of light which might indicate a solid nucleus; there was no resolvable appearance in the Coma, and the very minute stars with which that part of the sky was dotted, were visible almost to its very centre. Only one view of the moon was obtained, March 20th, and it was shared with them by several visitors, who, when once in possession of the telescope, were by no means disposed to make way for the astronomers. The fascination of the sight is, indeed, such, that one can scarcely withdraw the eye: Dr. Robinson, therefore, and his friend, had but little time for observation. He was, however, much interested by the vicinity of the craters named Hansteen and Mairan, in the map of Beer and Mædler, where, besides the crowd of hills described by them, there are an infinity of others not visible even in the three-feet, but looking in this with 560, like grains of sand. Are these fragments ejected from the crater? If so, and if they occur round others, it would explain what had always presented to him a great difficulty. The lunar craters differ widely from those of earth; and most in this, that their depression below the general surface is enormously greater than the elevation of their walls above it, while the area of the hollow is far greater than that of the latter. What, then, became of the materials which had once filled it? He had formerly supposed that they were in a fluid or gaseous state when ejected; but the fact just mentioned seems to give the true solution, and appears to account for them when combined with the consideration of the feeble gravity on the moon, which would permit the exploded fragments to be scattered over a far larger space than with us. Another beautiful object was the river-like valley that runs northward from the crater Herodotus: its raised banks, and their irregularities, were easily seen; the internal and external shadows could have been satisfactorily measured had a micrometer been applied. As it was, the much greater breadth of the former showed at a glance that this strange channel was sunk deep below the lunar surface. Taking as a standard the measures given there by Beer and Mædler, he had no doubt that they then saw *without difficulty* spaces of eighty or ninety yards. It is difficult to say *à priori* what should be the minimum

visible at the moon in such a telescope. If we assume, as one extreme, the statement of Amici, that the non-coincidence of two black lines on paper can be seen at twenty-eight feet, when it amounts to one-twelfth of an inch, or subtends 51″, then 311 feet should be visible at the moon with 1000. On the other hand, Jurin states (Smith's Optics) that a piece of silver wire can be seen on white paper, when it subtends 3″, a result depending on the intensity of this metallic reflection. This would give eighteen feet! Dr. Robinson finds that he can see the spider lines of his circle without much contrast of light, when they subtend to him 16″. This gives ninety-seven feet; but it must be remembered that aperture influences visibility as well as magnifying power, though we cannot, as yet, estimate its effect numerically.

The most important part of their observations were made on nebulæ; and, besides establishing completely the prodigious superiority of this instrument over all yet constructed, they have added some facts to our knowledge of these mysterious objects. A list of them was formed from the invaluable catalogue of Sir John Herschel, (Phil. Trans. 1833,) comprising such as, from brightness or any other peculiarity, seemed deserving of notice; of which forty were examined by Dr. Robinson and also by Sir James South, except some which the latter lost while making the transit observations required for the meridian line.* They may be separated into three classes; those which are round and of nearly uniform brightness;† those which are round, but appear to have one or more nuclei;‡ and those which are extended in one direction, sometimes so much as to become long stripes or rays.§ Of the first class, all that are examined are easily resolved, even with a triple eye-piece of wide field and power 360, used for finding the objects. In 854 the stars were seen through haze; in 1929 during twilight; and 1833 was noted as "consisting of rather coarse stars, and resembling Messier 13." Any increase of brightness towards the centre seemed to proceed from the greater depth of stars there rather than from any notable difference of their magnitude. But the second class presents much more interesting phenomena: the appearances which previous observers had described as *sudden condensation. nuclei*, or even single or multiple *central stars*, proving to be clusters of comparatively bright stars, surrounded by much larger collections of minute ones. A very beautiful example of this is 1456, fig. 41, M. 94, described in the catalogue as "very suddenly much brighter, almost up to a nipple-shaped nucleus:" it proved, however, to be "a vast circular cluster of stars, with ragged filaments, in which, and apparently central, is a globular group of much larger stars, power 400." The same system of arrangement (which seems very common) occurs

* Sir James South published an interesting and instructive notice of this telescope in the Times, April 16, 1845.

† Nos. 538. 739, 777, 844, 845, 854, 1797, 1833, 1907, 1929.

‡ Nos. 564, 706, 711, 743, 748, 749, 805, 843, 846, 1146, 1385, 1456, 1622, 1881.

§ Nos. 536, 604, 668, 791, 792, 810, 859, 1066, 1132, 1148, 1352, 1357, 1368, 1466, 1926. The numbers and the figures cited in the text are those of Sir John Herschel's catalogue.

also in 706, 748, 805, and many others: it is also found in the magnificent clusters 1663, M. 3; 1558, M. 53; and 1916, M. 5. In these, the splendor of which is not to be described, besides the stars visible in other instruments (which here seem of the first or second magnitude), the whole field is crowded with others much smaller, to such a degree that, had the first been absent, these would still have been noted as remarkable objects. The interior group is not, however, always central or symmetrical, but has knots of greater condensation, which sometimes (as in 1385) are alone visible in smaller telescopes, and then look like "twin nebulæ;" at others, (as in 739,) like stars. In 1622, fig. 25, M. 51, which is so well known from a sort of resemblance to Saturn, and from the more exact analogy which, as Sir John Herschel has well remarked, it bears to the Milky Way, we have another different development of this arrangement. Here, also, the central nebula is a globe of large stars; as indeed had been previously discovered with the three feet telescope: but it is also seen with 560 that the exterior stars, instead of being uniformly distributed, as in the preceding instances, are condensed into a ring, although many are also spread over its interior. Were the centre absent, we should have a ring nebula;* and were the line of vision near the plane of this ring it would become one of those rays with a bright nucleus and parallel band or satellite nebulæ which occur so frequently in the catalogue. In comparing it with our own sidereal system, Dr. R. thinks we should consider the stars visible to the naked eye, and the larger telescopic classes as constituting the central cluster, while the Milky Way represents the exterior and minuter stars either disposed in an irregular ring, or in a stratum, two of whose dimensions are much greater than the third. We have no reason for believing that the comparative brightness of stars depends *only* on their distances; 61 Cygni is not more remote than α Lyræ; much less can we assume that our stars are uniformly distributed: Orion, the Pleiades, Præsepe, the clusters in Perseus, M. 36 and 37, with many others, are evidently mere knots of condensation in our immediate neighborhood, our peculiar cluster; and it seems a mere arbitrary assumption to fancy that, were we transported to a remote part of the milky way, we should see anything similar to our present sky.

The nebulæ of the third class which were examined seemed to differ from this type only by being seen obliquely, and therefore projected into ellipses sometimes almost linear. In this last case they proved much more difficult of resolution, probably from greater *optical* condensation, and yielded most easily towards their minor axes. In these the nucleus of brighter stars is sometimes extended like the exterior portion, as in 602, which is of considerable length and easily resolved: the central part has three knots, of which two are represented in fig. 70, all the rest having been invisible. 668 is similar, but the central part is of more uniform character. In general, however, the nucleus

* It is possible that the exterior part of M. 94 may be merely a circular *disk* of stars: the absence of the central globe would make this a planetary nebula: but it is possible that these differ from the annular only in degree; all the latter which he has seen having faint nebulosity within them.

is globular, and remarkable from the comparative smallness of its diameter, and its very condensed appearance. Either the stars which compose it are few in number, or more closely compacted than is usual. 1132, M. 98, is a good example: "the long ray is resolved, except at the very extremities, with 560; the globular nucleus is seen with 1280 to consist of very close stars." 1148, described as "a nucleus with two branches, a star north following," appeared to Dr. R. as "an irregular ring of stars round a brighter group, but having an appendage like that of M. 51, in which is the bright star seen by H." 1357, fig. 37, is a similar object, both "the ray and appendage being full of stars, but the nucleus requires a higher power to resolve it than the night will bear." In 1466, fig. 84, *the nucleus projects on each side of the ray*, so that its diameter must be greater than the thickness of the exterior stratum.

He could not leave this part of his subject without calling attention to the fact that no REAL nebula seemed to exist among so many of these objects chosen without any bias: all appeared to be clusters of stars, and every additional one which shall be resolved will be an additional argument against the existence of any such. There must always be a very great number of clusters, which from mere distance will be irresolvable in any instrument; and if it prove to be the case that *all* the brighter nebulæ yield to this telescope, it appears unphilosophical not to make universal Sir J. Herschel's proposition, that "a nebula, at least in the generality of cases, is nothing more than a cluster of discrete stars."

These observations will suffice to show how much may be hoped from this telescope; but they are far from being a fair measure of its powers, being made at very low temperatures. Almost always the thermometer was at 22°, or 20°, when they ceased working; and on one occasion it was as low as 17°, the lowest he remembered in Ireland. In such circumstances it is notorious that even small reflectors act very imperfectly: and he was therefore unprepared for any tolerable action of this gigantic speculum. In the day time it was, of course, colder than the air, and, if uncovered before that had sunk to its temperature, was covered with dew: when this went off it always defined sharply. The huge mass of metal cooled much more slowly than the atmosphere; and as the difference increased, the performance of the telescope was deteriorated. This arose from no change of figure, as he satisfied himself by throwing the stars out of focus; it was probably the result of currents in the tube occasioned by this difference of temperature. How far it will be possible to obviate this by mechanical means, remains to be tried; but it is certain that the inconvenience does not increase in a higher ratio than the power of the telescope, as he had formerly apprehended. On the same nights, it defined quite as well as the three-feet with a far lower power; and therefore, it is reasonable to expect that it can be used with advantage much more frequently than he once supposed.

Enormous as is its illuminating power, it might be increased one-third, by using it with the front view, supposing it can be properly figured for this oblique action. Without that, he fears that in an in-

strument where the aperture is so large compared with the focal length, the definition would be imperfect. He verified this by an experiment with the three-feet, and found that though the light was increased quite as much as he expected, yet the perfection of the image was utterly destroyed for large stars. There was no exact focus, but merely two places where the sections of the cone of rays were smallest. One, the least exceptionable, shewed a flare in the direction of the slope like a comet's tail: at the other this disappeared, but the star became a sort of curved rectangle with rays from its corners. In the Newtonian form this speculum, a few nights before, had defined ζ Orionis very well with 500; but now γ Leonis could not be seen double with any power; the companion of Rigel (some way from the meridian however) was lost in the flare, and even that of Polaris, though perfectly visible, was sadly disfigured by it. It was, of course, useless to try more difficult tests, as even this degree of imperfection would make it utterly incapable of resolving such objects as the nuclei of the long nebulæ, be its illuminating power what it may. One thing, however, deserves notice, that in consequence of removing the second reflection, the colors of the stars come out with extraordinary splendor.* ξ Cygni, for instance, had a pureness and brilliancy of yellow, in the large star, which was new to him, though he had seen it in many first-rate telescopes. Lord Rosse does not apprehend any insurmountable difficulty in applying his method to give the form necessary for aplanatic oblique reflection: more than one plan for this has occurred to him; and Dr. R. believes it is his purpose, as soon as the six-feet has its machinery completed, to try them on one of the three-feet specula, and, if successful, to alter the great one.

As it is, Dr. R. congratulates the Academy and their country on the success of this matchless instrument; to which, as nothing at all approaching to its power has yet existed, so it is not probable that there will soon be any superior. It has been reported that the French Government, at the suggestion of M. Arago, are about to construct an achromatic of a metre aperture. Supposing homogeneous disks of glass can be obtained and wrought of that magnitude, there remain other difficulties. The optician who proposed to supply them stated that they would weigh at least 400 pounds; now these, when mounted, must be supported by at most two lateral bearings; and it is known that a very moderate pressure produces in glass a double refraction, most injurious to its performance in an object glass. But supposing this and the equally probable change of curvature from the weight of the lenses obviated, still such an achromatic would be far below the six-feet in quantity of light. From Amici's experiment with an object glass of two and a half inches it follows that it equals a Newtonian when their acting surfaces are as six to ten: this would imply in the great one an aperture of fifty-six inches, and a focal length of eighty feet. But the absorption certainly increases with the thickness

* The lenses of achromatics have often a tinge of green or straw color, which modify the color of objects seen through them. Something of this may, perhaps, cause the predominance of green and "cinereus" which exists in the Dorpat catalogue.

of the medium, though neither the law of this, nor the loss by the reflections at the four surfaces, are accurately known. Mr. Potter found that a good object glass, by Dollond, of four inches aperture and six feet focus, transmitted but 0·66 of the incident rays. This gives the ratio of the equivalent surfaces 0·74, and it will be still greater where the glass is three or four inches thick. It is said that the construction of a reflector still larger than this is contemplated by a northern Sovereign, who has already shown himself a most munificent patron of Astronomy. If so, none will rejoice more than Lord Rosse himself. It was not the mean desire of possessing what no other possessed, or seeing what no other had seen, that induced him to bestow so many precious years on this pursuit: had such been his motives, he would have kept to himself his methods, instead of opening his workshops, without reserve, to all who had the slightest desire of following his steps, and communicating in the most liberal manner the fruits of long and painful experience. His sole object is to extend the domain of astronomical knowledge: and the more common such instruments become, the more perfectly will it be fulfilled.

On the Manufacture of Gas.

The great and growing importance of the adoption of the most economical and perfect methods of distilling coal for the production of carburetted hydrogen for artificial illumination, induces us to give the following general view of a paper on that subject, read at the Western Literary and Scientific Institution, Leicester-square, although but a few months since we gave, at considerable length, the very able lectures delivered by Mr. T. A. Hedley, at the Devonport Mechanics' Institution.

In 1739 appeared the first account of attempts to distil coals in close vessels, or retorts, and collect the products of gas in bladders for experiments: and which experiments were frequently made and continued up to 1792, a period of upwards of 50 years, during which time, although the practicability of easily procuring a cheap and beautiful artificial light by the distillation of coals had been so repeatedly manifested, still the tardy nature of men's minds, and the total absence of disposition for improvement, prevented any steps being taken for the introduction of so valuable a discovery.

In 1792, Mr. Murdoch, a talented engineer of the time, residing at Redruth, in Cornwall, where he was employed in introducing the then newly invented steam engine of the celebrated James Watt, for draining the deep mines of that county, constructed an experimental coal-gas apparatus, and lighted his dwelling. After this he removed to Soho, near Birmingham, to the steam engine factory of Bolton and Watt, where he lighted their manufactory, and other places. The plan adopted at this period was of the most primitive kind, being merely a close cast-iron vessel fixed in a furnace, in which, on its being partially filled with coal, and made red hot, the gas was generated,

and conveyed away in pipes, in its crude and impure state, to the burners. In the introduction of such a valuable discovery, this state of things could not long remain; the shopkeepers soon discovered the injurious effects of sulphuretted hydrogen on their goods, whilst the air of rooms became so contaminated by sulphur and carbonic acid, as to be extremely unwholesome, and depressing to animal life. Lime was found to be a complete, convenient, and cheap material to remedy the evil, for the discovery of which there are several claimants. It was at first mixed with the water contained in the tank of the gas holder; the gas being delivered by a pipe a little below the surface, it rose in bubbles through the lime-water, and as a stronger affinity exists between the impure gases and lime than for carburetted hydrogen, this gas only was set free, and escaped above the water ready for use. This plan was soon found very inconvenient, from the difficulty of removal when saturated; the separate lime vessels remedied the defect, which, with the hydraulic main, are said to owe the honor of their invention to the fertile genius of Mr. S. Clegg, the former in 1805, and the latter in 1809. About this time, gas lights were exhibited in London by Mr. Winsor; and by 1819, 288 miles of gas pipes had been laid in the streets of London. In the construction of apparatus for the production of gas, there is first, the distillatory process in cast-iron retorts; secondly, the refrigeratory, or cooling process, which partly takes place in the hydraulic main, and finally in the condenser; and, thirdly, the purifying process, in which the impure gas, as it escapes from the condensers, is rendered fit for consumption.

In no part of the gas apparatus has there been greater ingenuity displayed than in the retorts; and, indeed, as they form the principal item of expense in wear and tear of a gas station, it is of the highest importance to ascertain the kind and form which shall produce the greatest bulk of good illuminating gas from a definite weight of coals, and that they shall be as durable as possible, at the least cost—cast-iron ones seldom lasting more than from nine to twelve months, when they become old iron of the most valueless description. Cast-iron is almost universally used, the dimensions being from six to seven feet long, one to two feet wide, nine to eighteen inches high, from 1¼ to 1½ inches thick, and weighing from 10 to 15 cwts. The forms are various—square, round, oval, flat D, high D, kidney-shaped, &c.—but the D shape is found the prevailing form. At the old company's works, at Liverpool, wrought-iron retorts have been used for many years, the sides and top being made of iron plates, riveted to a cast-iron bottom—length six to eight feet, width about four feet; and it is stated that they were found more efficient and economical than cast-iron ones. At Glasgow, Paisley, and many places in the north of England, retorts are made of fire-clay, generally of larger dimensions than those of cast-iron, the form being D shaped, and from three or four to five inches thick. The manner of setting iron retorts is as much varied as their forms. In small towns requiring but a limited supply of gas, they are set singly; but when a greater supply is necessary, they are set two or three in one fire; and in the largest establish-

ments, the furnaces are of such various dimensions as to contain from three to even nine retorts.

With respect to the production of gas, as to quantity and quality, there is as great a variety as there is in the coals from which it is obtained—some Scotch coals producing as much as 10,000 cubic feet per ton, which would fill a room 100 feet long, 10 feet high, and 10 feet wide. English coals do not produce so much, but probably may be taken on an average at about 8000 cubic feet per ton; and as the greatest portion of the gas is given out in the early part of the distillation, it follows that it must pass rapidly from the hydraulic main; yet, however short the time may be, a large quantity of tar and ammonia is reduced from the gaseous to the fluid state in that vessel, and runs off in the lower part of the main to the tar cistern.

The duration of the process of distillation depends on the quantity of coals in the retorts. Gas managers entertain various opinions on this head, although it is agreed that thin strata and quick distillation produced the greatest quantity of rich gas. When the charge is fully carbonized, the doors are taken off, and the red hot coke drawn out by rakes. As soon as possible after drawing, the retorts are charged again, to prevent any loss of heat by their being left unnecessarily open.

The next portion of the apparatus for consideration is that of condensation. In all well arranged works there is what is called a refrigerator, or condenser, which consists of a considerable length of pipe, through which the gas has to pass, surrounded on the outside with cold water, for the purpose of extracting as much as possible of the heat from the gas. The last process to complete the manufacture of gas for the consumer is that of purification, by which the remaining gaseous impurities which have escaped the condensers, not being condensible, have to be removed by chemical action. For this purpose, two methods are in use, one being that of passing the gas through lime-water—being a mixture of one part slaked lime to 20 or 30 parts of water, being of a consistency very similar to plasterers' lime-wash. The other is that called the dry process, in which the lime is slaked, allowed to cool, and as much water added as to cause it to feel damp, and to retain its shape on being squeezed in the hand, similar to garden mould, or brown sugar. In each of these plans, the gas is passed through successive vessels, until it is thoroughly purified from the sulphur and ammonia with which it is contaminated. The weight of the gas-holder is generally such as to produce a density, or pressure, on the gas of about two ounces per square inch, producing an upward pressure on the cover of the purifier of 18 lbs. per square foot, and which is, consequently, held down by suitable fastenings to the body of the box.

As obstructions occasionally occur in the condenser, or other pipes, between the purifiers and the retorts, by the deposition of napthaline tar, &c., all well arranged works should be furnished with a self-acting escape for the gas, which is being continually generated by the retorts, placed in some conspicuous situation, so that it may be instantly seen when such a contingency takes place. All that is required for

this purpose, is an upward opening in the pipe at the end of the hydraulic main, with a water-joint to receive a cylindrical cover, like an inverted cup, dipping into the water-joint, and fastened down. Of course, the depth of this cup, or the altitude of the water, must be more than equal to the resistance arising from all sources, such as the friction of the gas through the condensers, the altitude of water resistance in the wash vessel, the purifiers, and gas-holder.

The gas-holder, being merely a vessel of large capacity for containing the gas as purified, is of a most simple kind, not susceptible of much variety, the form first used being still continued, consisting of two parts. The first consists of a circular vessel, or tank, in the ground, with upright sides of brick, or stone, and rendered water-tight by being plastered all round with plastic clay; the pipe conveying the gas from the purifiers is carried down a dry well, rather below the level of the bottom of the tank; at the lowest extremity of the pipe in the well, there is a small close vessel for receiving the liquid ammonia which becomes condensed, and in which is inserted a hand-pump, to draw it off. The inlet pipe is continued under the wall of the tank, and carried upwards to a few inches above the water-level. The gas-holder is a sheet-iron cylinder, open at bottom and closed at top, about a foot less in diameter than the tank; it is made of iron, about one-sixteenth of an inch in thickness, the top being rather stouter, and supported by rafters, suspension truss-rods, &c., and is kept upright in rising by rollers and guide wheels. The great increase in the demand for gas has correspondingly increased the size of the gas-holder; for whereas 50 feet diameter was, 20 years since, considered excessive, they are now made upwards of 100 feet, and of corresponding height. To save the covering so large a superficial quantity of ground, the telescopic gas-holder was invented. This will contain two, three, or four times the cubic contents of the tank, according to the number of slides, and each of them is rendered gas-proof at the edges by having a trough all round, which fills with water when down in the tank, and into which a flanch on the top of the next dips, thus making a water seal. It has been observed that the weight of the gas-holder compresses the gas to a density equal to an altitude of three or four inches of water, but this must be varied to suit the conditions of the district, the distance between the stations of manufacture and consumption, &c. In addition to this, the immense quantity necessary to be sent out in the beginning of a dark winter evening, when almost every light is in full blaze, requires very nice management so to proportion the pressure, that every one may have fair and ample quantity. This was at first done by a common valve, regulated by hand, but it soon became apparent that a better contrivance was necessary. The gas-governor was, therefore, invented. This apparatus is fixed at the gas station, between the gas-holder and the mains; though not quite self-acting, it is, perhaps, as nearly so as possible, to meet the varying circumstances of demand. It consists of a small gas-holder, balanced by a number of shifting weights, by which its specific gravity, when more or less immersed in the water, regulates the supply to the demand, under whatever pressure it is adjusted. The gas enters

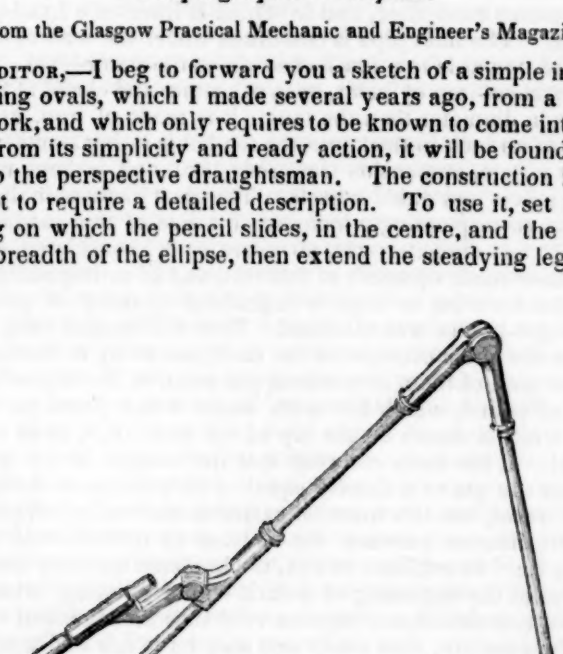
through a centre pipe, in which there is an iron cone suspended; the top has a plate, with a hole perfectly circular, to fit the base of the cone. It is, therefore, clear that if this cone is drawn up close, no gas can escape—but if, on the contrary, quite down, a full flow will take place. The superintendent, therefore, in the beginning of the evening, takes off as many weights, as will adjust the annular orifice between the cone and the cap-plate, to produce the pressure required, which is indicated by a gauge in the top of the vessel. The gas in this governor is, of course, under the constant pressure of the main gas-holder.

The last portion of this subject, which interests the public, is the meter, which, as we have so often treated on before, and as an article on the subject will be found in another column, we must here close these remarks. Lond. Min. Jour.

Elliptographic Compass.

(From the Glasgow Practical Mechanic and Engineer's Magazine.)

Mr Editor,—I beg to forward you a sketch of a simple instrument for drawing ovals, which I made several years ago, from a figure in an old work, and which only requires to be known to come into general use, as, from its simplicity and ready action, it will be found of great service to the perspective draughtsman. The construction is so simple as not to require a detailed description. To use it, set the point of the leg on which the pencil slides, in the centre, and the pencil to the half breadth of the ellipse, then extend the steadying leg until the



pencil, as in the position shown in the figure, cuts the length; steady the instrument with one hand, and with the other turn the pencil round, allowing it to slide up or down its guide, so as to keep the point pressing lightly on the paper. It must be clear that the figure described by the revolution of the pencil is a perfect ellipse, as it is an oblique section of a cylinder. When the ellipse is very long, this in-

strument will not answer well, but for a large proportion of those which occur in perspective, it will be found very useful; in this I can speak from experience.

I have shown both legs adapted to receive the pencil, and those of different lengths, as it will be more convenient than the old form with one round leg, if the ellipse is wanted nearly circular.

Yours, &c. G. H. S.

Improvements in Blast Furnaces, patented by Mr. James Yates, *Masborough, Yorkshire, December* 14, 1846.

The patentee states, that it is usual to keep the charge, in blast furnaces of ordinary construction, for as long a time as is compatible with the iron made; and that it is deemed beneficial to continue *the cementing process*, which is the result of the iron-stone, or ore, and fuel, being subjected to a great degree of heat for several days; but that he believes this system of operation to be erroneous.

Again, under the system which has hitherto prevailed, furnaces are kept filled up to the funnel-head, through which the flame and unconsumed products pass on escaping from the charge; and these furnaces are constructed in the form of two cones united at their bases, or of a cylindrical form at top; both of which forms of construction offer scarcely any obstacle to the free escape of caloric with the unconsumed products.

Now Mr. Yates proposes *firstly*, to arch in the upper part of the furnace, and diminish its height, in order that a very considerable portion of heat, instead of escaping as heretofore, may, after striking against the even surface of the dome, be deflected on the top surface of the "burden" and absorbed by it. *Secondly*, to place feed-doors, by which the material may be introduced in the side, at that point of junction between the dome and the bottom part of the furnace which allows of the largest surface of the burden being exposed to the action of the deflected heat (care being taken to maintain a sufficient and uniform space between the dome and top of the "burden" for the purposes of reverberation); by which mode of charging the furnace the "burden" is hollow in the centre, and therefore offers less resistance to the blast, which is regulated by means of dampers suitably placed in the chimney. And *thirdly*, to employ a greater number of tuyeres, and to distribute them more equally round the hearth of the furnace than has yet been customary; and to provide each tuyere with a separate house, in order that the blast may act more regularly on the "burden."

The results of these alterations are stated to be saving in the prime cost of erection, and economy both in fuel and in engine power.

Mr. Yates instances a furnace, built according to his invention, which was 20 feet from the hearth to the top of the "burden," and had six tuyere pipes of seven-eighths of an inch in diameter; with this furnace he produced, employing a hot blast at a pressure of 1½ lbs.

to the square inch, 110 tons of iron, from lean Derbyshire ore, in one week.

The patentee proposes to adapt his plan of construction to existing furnaces, by building the dome in the top, or other part of the shaft, and providing feed doors, together with the necessary holes for the extra number of tuyere pipes.

After pointing out various modifications of which his invention is susceptible, such as, the substitution for tuyere pipes, of a circular passage, with grating to keep in the "burden," Mr. Yates proceeds to describe a peculiar apparatus for feeding by the chimney instead of by side doors, which enables him to obtain the same result, viz., the distribution of the material around and upon, and not in, the centre of the "burden." The apparatus referred to is fixed in the dome, and consists of a cone, having an aperture in its centre for the passage of unconsumed products, and is adjusted to the required size. The cone is made fast to a lever passing through the chimney, and weighted at the outside end; so that when there is no disturbing force, its weight shall keep the cone wedged tight up into the dome, and leave no room for the escape of any vapor or caloric, except through the aperture. A feed-box is suspended in the chimney, and has a conical bottom, similarly connected to a weighted lever, which, when the box is filled, falls down, and allows the passage of the material; the centre aperture of the under cone being covered by the bottom of the feed-box. The weight of the material falling on the surfaces of the under cone, overcomes the weight at the end of the lever, and depressing the cone, passes into the furnace around the sides. When there is no longer any weight on either the cone portions of the dome, or the conical bottoms of the box, they both return to their places.

Other modifications described in this specification are, the connecting two or more furnaces to a common chimney, by flues provided with dampers to regulate the draught; the making the furnace of as great a diameter at the bottom, just above the hearth, as at the other point of junction with the dome, or even greater: and a peculiar construction of tuyere box, to avoid, in a great measure, the melting of the tuyere pipes.

The patentee describes, lastly, some improvements relating to steam-engines and cylinders employed in blasting, which may be said briefly, to consist in working two engines together, by connecting the slide valves and rods of the one to the piston-rod of the other, and *vice versâ*, so that the piston at work shall open the valves of the one at rest; and in using an elastic cylinder attached immovably at one end to the main, and at the other to the piston-rod. By the use of this elastic cylinder, Mr. Yates states that a more regular pressure of the blast may be obtained. London Mec. Mag.

Description of Brett & Little's Electric Telegraph.

We have witnessed an exhibition of the improvements effected by Messrs. Brett and Little, of Furnival's Inn, in the construction and work-

ing of that marvel of modern science, the electric telegraph:—and will borrow a description of the same for the information of our scientific readers:—"The inventions of Messrs. Brett and Little aim at increasing the efficiency of the electric telegraph, in the first place, by generating and economizing a more constant and powerful electric current; and secondly, by a new arrangement of the dial and indicator, insuring that communications may be made more safely and certainly than by the system now in use. The increased power is attained by a process which frees the copper and zinc plates in the batteries from the sulphate of zinc which ordinarily accumulates upon them, and which soon diminishes their force. Messrs. Brett and Little's apparatus consists of three troughs, placed one above another. The highest is a reservoir containing the exciting power, a diluted sulphuric acid; the middle trough is the galvanic battery, containing the copper and zinc plates, divided by cells or compartments of fine sand; and the lowest trough receives the vitiated liquid, which, having slowly dropped from the reservoir into the battery, has filtered through the sand in the latter, and thence percolates, drop by drop, into the receiving trough below. The diluted sulphuric acid drops from the reservoir into the galvanic battery through small cones perforated at the bottom,—and is carried from the bottom of the galvanic trough by corresponding cones and perforators into the receiving trough. The sand which surrounds the metallic plates is thus constantly saturated; and, as a constant supply of fresh acid is kept up, and the vitiated fluid as constantly escapes below, the formation of crystals of the sulphate of zinc is prevented by this self-cleansing process, and the whole surface of the plates is exposed to the action of the acid. The fluid in the receiving-trough is found to contain large quantities of the sulphate of zinc, which would, in the ordinary mode, have adhered to the plates, and prevented the action of the acid upon the metal. The second feature in the invention of Messrs. Brett and Little is the new alphabet, and the altered face of the dial adopted by them. The indicators attached to the dials hitherto in use are generally magnets, and their incessant vibration, through electrical and other disturbing atmospheric causes, has produced much uncertainty and confusion in communications. The indicators in the dial before us are not magnets, and show no vibration whatever. Another point of difference is, that in the dial of Messrs. Brett and Little, every letter in the alphabet is given, with the means of expressing it,—so that no symbols or arbitraries need be used, and a sentence may be perfectly and entirely spelled, and transmitted as it is written."—In one of their rooms, the patentees have seventeen instruments fitted up to represent seventeen stations; and the electric current passes through coils of wire, to each of these instruments, equal to 1000 miles in length. There are other devices and improvements in the same exhibition, such as a new and ingenious bell apparatus, lightning-conductors, and insulator. The whole is well worthy the attention of scientific men. London Athenæum.